

similar to curve 22 in Fig 2 was selected for the reservoir end of the compound wick.

Capillary pressure gradients were calculated and an interface pressure was chosen such that the thickness of the layer of Teflon felt was conveniently available — 0.15 centimeters thick. The required thickness of the Cerafelt material was determined to be 3.8 centimeters. After determining the no-flow and steady state flow saturation gradients, it was calculated that the wick would undergo only a 2% change in saturation when going from no-flow equilibrium to steady state flow equilibrium.

Similar good results were obtained using a wick made from Nomex felt S-1921N, available from Globe Albany, Co. and #10 Cerafelt (above) with a silicone oil, DC 200 (60,000 centistokes), available from Dow Corning.

Disclosed anonymously (R 2476)
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Film cartridge

This disclosure relates to a film cartridge having supply and take-up chambers located behind the cartridge exposure aperture to shorten the overall cartridge dimensions.

Referring first to Fig 1, the cartridge is depicted schematically with take-up and supply chambers 11 and 13, respectively, located close together, in tandem, behind exposure aperture 15. Independent chambers are illustrated, but it should be apparent that the chambers could overlap, so the take-up convolutions would expand into the supply chamber as the supply convolutions are depleted therefrom.

A more complete design is presented in Fig 2, including supply and take-up spools 17 and 19, a slip clutch 21, which accommodates changes in the rotational velocity of the take-up spool as its diameter increases, and a pinion gear 22 drivingly connecting the supply and take-up spools. In use, the take-up spool is driven by a suitable key 23 to sequentially advance the film, one frame after another, from the supply spool to the exposure aperture, and then onto the take-up spool. The gearing ratios between the spools and the pinion gear are chosen to advance the take-up spool at an angular velocity that is always fast enough to maintain the film in the gate under some tension. Undesirable forces that might otherwise build-up as the take-up diameter increases are relieved by slippage in the clutch 21.

Fig 3 and 4 depict alternate embodiments in which the film is advanced and metered by a metering spool 25, which is substituted for the pinion gear 22 of the first embodiment. This spool includes opposed pawls 27 and 29 which act through perforations 31 in the film. Again, the driving connection between the metering and the take-up spools is through a slip clutch.

In still another embodiment, not depicted, the film could be advanced by a camera claw acting through the film perforations, somewhat like a typical movie camera.

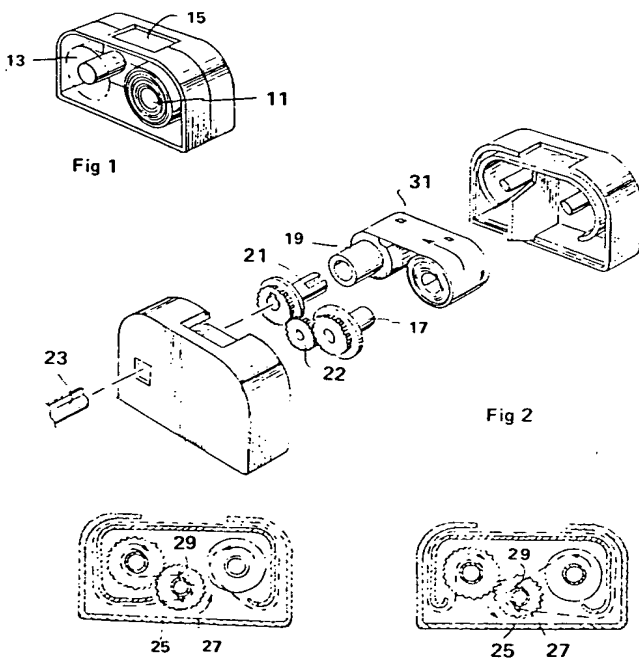


Fig 3

Fig 4

Disclosed by William Allen Martin
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Photographic silver halide emulsions, preparations, addenda, processing and systems

LR 31332

Identification of patents herein is for the sole purpose of referring to their disclosures and not to any aspect of their validity or enforceability as patents or the availability of licenses under them.

1 Emulsion preparation and types — J.W. Carpenter, contributor

A The silver halide emulsions can be comprised of silver bromide, silver chloride, silver iodide, silver chlorobromide, silver chloriodide, silver bromiodide, silver chlorobromiodide or mixtures thereof. The emulsions can include coarse, medium or fine silver halide grains bounded by 100, 111 or 110 crystal planes and can be prepared by a variety of techniques — eg. single-jet, double-jet (including continuous removal techniques), accelerated flow rate and interrupted precipitation techniques, as illustrated by Trivelli and Smith, *The Photographic Journal*, Vol LXXIX, May, 1939, pp 330-338, T H James, *The Theory of the Photographic Process*, 4th Ed, Macmillan, 1977, Chapter 3, Terwilliger et al *Research Disclosure*, Vol 149, September 1976, Item 14987, as well as Nietz et al US Patent 2,222,264, Wilgus German OLS 2,107,118, Lewis UK Patents 1,335,925, 1,430,465 and 1,469,480, Irie et al US Patent 3,650,757, Kurz US Patent 3,672,900, Morgan US Patent 3,917,485, Musliner US Patent 3,790,387, Evans US Patent 3,761,276 and Gilman et al US Patent 3,979,213. Sensitizing compounds, such as compounds of copper, thallium, lead, bismuth, cadmium and Group VIII noble metals, can be present during precipitation of the silver halide emulsion, as illustrated by Arnold et al US Patent 1,195,432, Hochstetter US Patent 1,951,933, Trivelli et al US Patent 2,448,060, Overman US Patent 2,628,167, Mueller et al US Patent 2,950,972, Sidebotham US Patent 3,488,709 and Rosecrants et al US Patent 3,737,313.

B The individual reactants can be added to the reaction vessel through surface or sub-surface delivery tubes by gravity feed or by delivery apparatus for maintaining control of the rate of delivery and the pH and/or pAg of the reaction vessel contents, as illustrated by Culhane et al US Patent 3,821,002, Oliver US Patent 3,031,304 and Claes et al, *Photographische Korrespondenz*, 102 Band, Number 10, 1967, p 162. In order to obtain rapid distribution of the reactants within the reaction vessel, specially constructed mixing devices can be employed, as illustrated by Audran US Patent 2,996,287, McCrossen et al US Patent 3,342,605, Frame et al US Patent 3,415,650, Porter et al US Patent 3,785,777, Saito et al German OLS 2,556,885 and Sato et al German OLS 2,555,364. An enclosed reaction vessel can be employed to receive and mix reactants upstream of the main reaction vessel, as illustrated by Forster et al US Patent 3,897,935 and Posse et al US Patent 3,790,386.

C The silver halide emulsions can be either monodisperse or polydisperse as precipitated. The grain size distribution of the emulsions can be controlled by silver halide grain separation techniques or by blending silver halide emulsions of differing grain sizes. The emulsions can include Lippmann emulsions and ammoniacal emulsions, as illustrated by Glafkides, *Photographic Chemistry*, Vol 1, Fountain Press, London, 1958, pp 365-368 and pp 301-304; excess halide ion ripened emulsions as described by G F Duffin, *Photographic Emulsion Chemistry*, Focal Press Ltd, London, 1966, pp 60-72; thiocyanate ripened emulsions, as illustrated by Illingsworth US Patent 3,320,069; thioether ripened emulsions, as illustrated by McBride US Patent 3,271,157, Jones US Patent 3,574,628 and Rosecrants et al US Patent 3,737,313 or emulsions containing weak silver halide solvents, such as ammonium salts, as illustrated by Perignon US Patent 3,784,381 and *Research Disclosure*, Vol 134, June 1975, Item 13452.

D The emulsions can be surface-sensitive emulsions — ie, emulsions that form latent images primarily on the surfaces of the silver halide grains — or internal latent image-forming emulsions — ie, emulsions that form latent images predominantly in the interior of the silver halide grains, as illustrated by Knott et al US Patent 2,456,953, Davey et al US Patent 2,592,250, Porter et al US Patents 3,206,313 and 3,317,322, Berriman US Patent 3,367,778, Bacon et al US Patent 3,447,927, Evans US Patent 3,761,276, Morgan US Patent 3,917,485, Gilman et al US Patent 3,979,213 and Miller US Patent 3,767,413.

E The emulsions can be negative-working emulsions, such as surface-sensitive emulsions or unfogged internal latent image-forming emulsions, or direct-positive emulsions of the surface fogged type, as illustrated by Kendall et al US Patent 2,541,472, Shouwenars UK Patent 723,019, Illingsworth US Patent 3,501,307, Berriman US Patent 3,367,778, *Research Disclosure*, Vol 134, June 1975, Item 13452, Kurz US Patent 3,672,900, Judd et al US Patent 3,600,180 and Taber et al US Patent 3,647,463, or of the unfogged, internal latent image-forming type, which are positive-working with fogging development, as illustrated by Ives US Patent 2,563,785, Evans US Patent 3,761,276, Knott et al US Patent 2,456,953 and Jouy US Patent 3,511,662.

F Blends of surface-sensitive emulsions and internally fogged, internal latent image-forming emulsions can be employed, as illustrated by Luckey et al US Patents 2,996,382, 3,397,987 and 3,705,858, Luckey US Patent 3,695,881, *Research Disclosure*.

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Vol 134, June 1975, Item 13452, Millikan et al *Defensive Publication* T-904017, April 21, 1972 and Kurz *Research Disclosure*, Vol-122, June 1974, Item 12233.

II Emulsion washing — J W Carpenter, contributor

A The silver halide emulsion can be unwashed or washed to remove soluble salts. The soluble salts can be removed by chill setting and leaching, as illustrated by Craft US Patent 2,316,845 and McFall et al US Patent 3,396,027; by coagulation washing, as illustrated by Hewitson et al US Patent 2,618,556, Yutzy et al US Patent 2,614,928, Yackel US Patent 2,565,418, Hart et al US Patent 3,241,969, Waller et al US Patent 2,489,341, Klinger UK Patent 1,305,409 and Dersch et al UK Patent 1,167,159; by centrifugation and decantation of a coagulated emulsion, as illustrated by Murray US Patent 2,463,794, Ujihara et al US Patent 3,707,378, Audran US Patent 2,996,287 and Timson US Patent 3,498,454; by employing hydrocyclones alone or in combination with centrifuges, as illustrated by UK Patent 1,336,692, Claes UK Patent 1,356,573 and Ushomirskii et al *Soviet Chemical Industry*, Vol 6, No 3, 1974, pp 181-185; by diafiltration with a semipermeable membrane, as illustrated by *Research Disclosure*, Vol 102, October 1972, Item 10208, Hagemair et al *Research Disclosure*, Vol 131, March 1975, Item 13122, Bonnet *Research Disclosure*, Vol 135, July 1975, Item 13577, Berg et al German OLS 2,436,461 and Bolton US Patent 2,495,918 or by employing an ion exchange resin, as illustrated by Maley US Patent 3,782,953 and Noble US Patent 2,827,428. The emulsions, with or without sensitizers, can be dried and stored prior to use as illustrated by *Research Disclosure*, Vol 101, September 1972, Item 10152.

III Chemical sensitization — J W Carpenter, contributor

A The silver halide emulsions can be chemically sensitized with active gelatin, as illustrated by T H James, *The Theory of the Photographic Process*, 4th Ed, Macmillan, 1977, pp 67-76, or with sulfur, selenium, tellurium, gold, platinum, palladium, iridium, osmium, rhenium or phosphorus sensitizers or combinations of these sensitizers, such as at pAg levels of from 5 to 10, pH levels of from 5 to 8 and temperatures of from 30 to 80°C, as illustrated by *Research Disclosure*, Vol 120, April 1974, Item 12008, *Research Disclosure*, Vol 134, June 1975, Item 13452, Sheppard et al US Patent 1,623,499, Matthies et al US Patent 1,673,522, Waller et al US Patent 2,399,083, Damschroder et al US Patent 2,642,361, McVeigh US Patent 3,297,447, Dunn US Patent 3,297,446, McBride UK Patent 1,315,755, Berry et al US Patent 3,772,031, Gilman et al US Patent 3,761,267, Ohi et al US Patent 3,857,711, Klinger et al US Patent 3,565,633, Oftedahl US Patents 3,901,714 and 3,904,415 and Simons UK Patent 1,396,696; chemical sensitization being optionally conducted in the presence of thiocyanate derivatives, as described in Damschroder US Patent 2,642,361; thioether compounds, as disclosed in Lowe et al US Patent 2,521,926, Williams et al US Patent 3,021,215 and Bigelow US Patent 4,054,457 and azaindenes, azapyridazines and azapyrimidines, as described in Dostess US Patent 3,411,914, Kuwabara et al US Patent 3,554,757, Oguchi et al US Patent 3,565,631 and Oftedahl US Patent 3,901,714. Additionally or alternatively, the emulsions can be reduction sensitized — eg, with hydrogen, as illustrated by Janusonis US Patent 3,891,446 and Babcock et al US Patent 3,984,249, by low pAg (eg, less than 5) high pH (eg, greater than 8) treatment or through the use of reducing agents, such as stannous chloride, thiourea dioxide, polyamines and amineboranes, as illustrated by Allen et al US Patent 2,983,609, Oftedahl et al *Research Disclosure*, Vol 136, August 1975, Item 13654, Lowe et al US Patents 2,518,698 and 2,739,060, Roberts et al US Patent 2,743,182 and 183, Chambers et al US Patent 3,026,203 and Bigelow et al US Patent 3,361,564.

IV Spectral sensitization and desensitization — J V Holtzclaw, contributor

A Sensitizing dyes

A The silver halide emulsions can be spectrally sensitized with dyes from a variety of classes, including the polymethine dye class, which includes the cyanines, merocyanines, complex cyanines and merocyanines (ie, tri-, tetra- and poly-nuclear cyanines and merocyanines), oxonols, hemioxonols, styryls, merostyryls and streptocyanines.

B The cyanine spectral sensitizing dyes include, joined by a methine linkage, two basic heterocyclic nuclei, such as those derived from quinolinium, pyridinium, isoquinolinium, 3H-indolium, benz[e]indolium, oxazolium, thiazolium, selenazolium, imidazolium, benzoxazolium, benzothiazolium, benzoselenazolium, benzimidazolium, naphthoxazolium, naphthothiazolium, naphthoselenazolium, thiazolinium dihydronaphthothiazolium, pyrylium and imidazopyrazinium quaternary salts.

C The merocyanine spectral sensitizing dyes include, joined by a methine linkage, a basic heterocyclic nucleus of the cyanine dye type and an acidic nucleus, such as can be derived from barbituric acid, 2-thioarbituric acid, rhodanine, hydantoin, 2-thiohydantoin, 4-thiohydantoin, 2-pyrazolin-5-one, 2-isoxazolin-5-one, indan-1,3-dione,

cyclohexan-1,3-dione, 1,3-dioxan-4,6-dione, pyrazolin-3,5-dione, pentan-2,4-dione, alkylsulfonyl acetonitrile, malononitrile, isoquinolin-4-one, and chroman-2,4-dione.

D One or more spectral sensitizing dyes may be used. Dyes with sensitizing maxima at wavelengths throughout the visible spectrum and with a great variety of spectral sensitivity curve shapes are known. The choice and relative proportions of dyes depends upon the region of the spectrum to which sensitivity is desired and upon the shape of the spectral sensitivity curve desired. Dyes with overlapping spectral sensitivity curves will often yield in combination a curve in which the sensitivity at each wavelength in the area of overlap is approximately equal to the sum of the sensitivities of the individual dyes. Thus, it is possible to use combinations of dyes with different maxima to achieve a spectral sensitivity curve with a maximum intermediate to the sensitizing maxima of the individual dyes.

E Combinations of spectral sensitizing dyes can be used which result in supersensitization — that is, spectral sensitization that is greater in some spectral region than that from any concentration of one of the dyes alone or that which would result from the additive effect of the dyes. Supersensitization can be achieved with selected combinations of spectral sensitizing dyes and other addenda, such as stabilizers and antifoggants, development accelerators or inhibitors, coating aids, brighteners and antistatic agents. Any one of several mechanisms as well as compounds which can be responsible for supersensitization are discussed by Gilman, *Photographic Science and Engineering*, Vol 18, 1974 pp 418-430.

F Spectral sensitizing dyes also affect the emulsions in other ways. For example, many spectrally sensitizing dyes either reduce (desensitize) or increase photographic speed within the spectral region of inherent sensitivity. Spectral sensitizing dyes can also function as antifoggants or stabilizers, development accelerators or inhibitors, reducing or nucleating agents, and halogen acceptors or electron acceptors, as disclosed in Brooker et al US Patent 2,131,038, Illingsworth et al US Patent 3,501,310, Webster et al US Patent 3,630,749, Spence et al US Patent 3,718,470 and Shiba et al US Patent 3,930,860.

G Dyes which desensitize negative-working silver halide emulsions are generally useful as electron accepting spectral sensitizers for fogged direct-positive emulsions. Typical heterocyclic nuclei featured in cyanine and merocyanine dyes well suited for use as desensitizers are derived from nitrobenzothiazole, 2-aryl-1-alkylindole, pyrrolo[2,3-b]pyridine, imidazo[4,5-b]quinoxaline, carbazole, pyrazole, 5-nitro-3H-indole, 2-arylbenzindole, 2-aryl-1,8-trimethyleneindole, 2-heterocyclylindole, pyrylium, benzopyrylium, thiapyrylium, 2-amino-4-aryl-5-thiazole, 2-pyrrole, 2-(nitroaryl)indole, imidazo[1,2-a]pyridine, imidazo[2,1-b]thiazole, imidazo[2,1-b]-1,3,4-thiadiazole, imidazo[1,2-b]pyridazine, imidazo[4,5-b]quinoxaline, pyrrolo[2,3-b]quinoxaline, pyrrolo[2,3-b]pyrazine, 1,2-diarylindole, 1-cyclohexylpyrrole and nitrobenzoselenazole. Such nuclei can be further enhanced as desensitizers by electron-withdrawing substituents, such as nitro, acetyl, benzoyl, sulfonyl, benzosulfonyl and cyano groups.

H Sensitizing action and desensitizing action can be correlated to the position of molecular energy levels of a dye with respect to ground state and conduction band energy levels of the silver halide crystals. These energy levels can in turn be correlated to polarographic oxidation and reduction potentials, as discussed in *Photographic Science and Engineering*, Vol 18, 1974, pp 49-53 (Sturmer et al), pp 175-178 (Leubner) and pp 475-485 (Gilman). Oxidation and reduction potentials can be measured as described by R J Cox, *Photographic Sensitivity*, Academic Press, 1973, Chapter 15.

I The chemistry of cyanine and related dyes is illustrated by Weissberger and Taylor, *Special Topics of Heterocyclic Chemistry*, John Wiley and Sons, New York, 1977, Chapter VIII; Venkataraman, *The Chemistry of Synthetic Dyes*, Academic Press, New York, 1971, Chapter V; James, *The Theory of the Photographic Process*, 4th Ed, Macmillan, 1977, Chapter 8, and F M Hamer, *Cyanine Dyes and Related Compounds*, John Wiley and Sons, 1964.

J Among useful spectral sensitizing dyes for sensitizing silver halide emulsions are those found in UK Patent 742,112, Brooker US Patents 1,846,300, 1,301, 1,302, 1,303, 1,304, 2,078,233 and 2,089,729, Brooker et al US Patents 2,165,338, 2,213,238, 2,493,747, 2,526,632, 2,739,964 (Reissue 24,292), 2,778,823, 2,917,516, 3,352,857, 3,411,916 and 3,431,111, Sprague US Patent 2,503,776, Nys et al US Patent 3,282,933, Riester US Patent 3,660,102, Kampfer et al US Patent 3,660,103, Taber et al US Patents 3,335,010, 3,352,680 and 3,384,486, Lincoln et al US Patent 3,397,981, Fumia et al US Patents 3,482,978 and 3,623,881, Spence et al US Patent 3,718,470 and Mee US Patent 4,025,349. Examples of useful supersensitizing dye combinations, of non-light absorbing addenda which function as supersensitizers or of useful dye combinations are found in McFall et al US Patent 2,933,390, Jones et al US Patent 2,937,089, Motter US Patent 3,506,443 and Schwan et al US Patent 3,672,898. Among desensitizing dyes useful as spectral sensitizers for fogged direct-positive emulsions are those found in Kendall US Patent 2,293,261, Coenen et al US Patent 2,930,694, Brooker et al US Patent 3,743,111, Mee et al US Patents 3,492,123, 3,501,312 and 3,598,595, Illingsworth et al US Patent 3,501,310, Lincoln et al US Patent 3,501,311, VanLare US Patent 3,615,608, Carpenter et al US Patent 3,615,639, Riester et al US Patent 3,567,456, Jenkins US Patent 3,574,629, Jones US Patent 3,579,345, Mee US Patent 3,582,343, Fumia et al US Patent 3,592,653 and Chapman US Patent 3,598,596.

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B Desensitizers

K The silver halide emulsions can include desensitizers which are not dyes, such as N,N'-dialkyl-4,4'-bispyridinium salts, nitron and its salts, thiuram disulfide, piazine, nitro-1,2,3-benzothiazole, nitroindazole and 5-mercaptotetrazole, as illustrated by Peterson et al US Patent 2,271,229, Kendall et al US Patent 2,541,472, Abbott et al US Patent 3,295,976, Rees et al US Patents 3,184,313 and 3,403,025 and Gibbons et al US Patent 3,922,545.

V Brighteners — T J Huttemann, contributor

A Optical brightening agents can be employed in the photographic elements, as is generally reviewed by Roosens, *Photographic Korrespondenz*, Vol 94, No 1, pp 3-11, and No 2, pp 19-26 (1958). The brightening agents can include stilbenes, as illustrated by Wirth et al US Patent 2,581,057, Williams et al US Patent 2,618,636 and James UK Patent 672,803; triazines, as illustrated by Williams et al US Patent 2,713,046 and van der Grinten Dutch Patent 74109; imidazolones, as illustrated by Sargent US Patent 2,571,706 and Libby et al US Patent 2,723,197; pyrazolines, as illustrated by Kendall et al UK Patents 669,590 and 712,764; triazoles, as illustrated by Williams et al US Patent 2,623,064, Baum et al US Patent 2,713,054 and Sartori US Patent 2,715,630; coumarins, as illustrated by Sartori US Patent 2,702,296 and Gold et al German Patent 911,368; acetylenes, as illustrated by Meyer German OLS 2,525,680; oxazoles and oxadiazoles, as illustrated by Heidke US Patent 3,513,102, and vinylene compounds, as illustrated by Tuite US Patents 3,788,854 and 3,789,012. These and other brighteners as well as methods of improving their stability are illustrated by Tuite US Patent 3,684,729. Water soluble brighteners can be dispersed directly in hydrophilic colloid layers of the photographic elements, as is further illustrated by UK Patent 440,032 and McFall et al US Patent 2,933,390, while hydrophobic brighteners can be dispersed in a manner similar to other hydrophobic photographic addenda, as further illustrated by Koerber et al US Patents 3,047,390, 3,181,949 and '950, Pattijn et al US Patent 3,359,102, Knott et al US Patent 3,434,837, Oetiker et al US Patent 3,406,070 and Jansen German Patent 1,150,274.

VI Antifoggants and stabilizers — J W Carpenter, contributor

A Instability which increases minimum density in negative type emulsion coatings (ie, fog) or which increases minimum density or decreases maximum density in direct-positive emulsion coatings can be protected against by incorporation of stabilizers, antifoggants, antikinking agents, latent image stabilizers and similar addenda in the emulsion and contiguous layers prior to coating. Most of the antifoggants which are effective in emulsions can also be used in developers and can be classified under a few general headings, as illustrated by C E K Mees, *The Theory of the Photographic Process*, 2nd Ed, Macmillan, 1954, pp 677-680.

B To avoid such instability in emulsion coatings stabilizers and antifoggants can be employed, such as halide ions (eg, bromide salts); chloropalladates and chloropalladites, as illustrated by Trivelli et al US Patent 2,566,263; water-soluble inorganic salts of magnesium, calcium, cadmium, cobalt, manganese and zinc, as illustrated by Jones US Patent 2,839,405 and Sidebotham US Patent 3,488,709; mercury salts, as illustrated by Allen et al US Patent 2,728,663; selenols and diselenides, as illustrated by Brown et al UK Patent 1,336,570 and Pollet et al UK Patent 1,282,303; quaternary ammonium salts of the type illustrated by Allen et al US Patent 2,694,716, Brooker et al US Patent 2,131,038, Graham US Patent 3,342,596 and Arai et al US Patent 3,954,478; azo-methine desensitizing dyes, as illustrated by Thiers et al US Patent 3,630,744; isothiourea derivatives, as illustrated by Herz et al US Patent 3,220,839 and Knott et al US Patent 2,514,650; thiazolidines, as illustrated by Scavron US Patent 3,565,625; peptide derivatives, as illustrated by Maffet US Patent 3,274,002; pyrimidines and 3-pyrazolidones, as illustrated by Welsh US Patent 3,161,515 and Hood et al US Patent 2,751,297; azotriazoles and azotetrazoles, as illustrated by Baldassarri et al US Patent 3,925,086; azaindenes, particularly tetraazaindenes, as illustrated by Heimbach US Patent 2,444,605, Knott US Patent 2,933,388, Williams US Patent 3,202,512, *Research Disclosure*, Vol 134, June 1975, Item 13452, and Vol 148, August 1976, Item 14851, and Nepker et al UK Patent 1,338,567; mercaptotetrazoles, -triazoles and -diazoles, as illustrated by Kendall et al US Patent 2,403,927, Kennard et al US Patent 3,266,897, *Research Disclosure*, Vol 116, December 1973, Item 11684, Luckey et al US Patent 3,397,987 and Salesin US Patent 3,708,303; azoles, as illustrated by Peterson et al US Patent 2,271,229 and *Research Disclosure*, Item 11684, cited above; purines, as illustrated by Sheppard et al US Patent 2,319,090, Birr et al US Patent 2,152,460, *Research Disclosure*, Item 13452, cited above, and Dostes et al French Patent 2,296,204 and polymers of 1,3-dihydroxy(and/or 1,3-carbamoxy)-2-methylenepropene, as illustrated by Saleck et al US Patent 3,926,635.

C Among useful stabilizers for gold sensitized emulsions are water-insoluble gold compounds of benzothiazole, benzoxazole, naphthothiazole and certain merocyanine and cyanine dyes, as illustrated by Yutzy et al US Patent 2,597,915, and sulfonamides, as illustrated by Nishio et al US Patent 3,498,792.

D Among useful stabilizers in layers containing poly(alkylene oxides) are tetraazaindenes, particularly in combination with Group VIII noble metals or resorcinol derivatives, as illustrated by Carroll et al US Patent 2,716,062, UK Patent 1,466,024 and Habu et al US Patent 3,929,486; quaternary ammonium salts of the type illustrated by Piper US Patent 2,886,437; water-insoluble hydroxides, as illustrated by Maffet US Patent 2,953,455; phenols, as illustrated by Smith US Patents 2,955,037 and '038; ethylene diurea, as illustrated by Dersch US Patent 3,582,346; barbituric acid derivatives, as illustrated by Wood US Patent 3,617,290; boranes, as illustrated by Bigelow US Patent 3,725,078; 3-pyrazolidinones, as illustrated by Wood UK Patent 1,158,059 and aldolximes, amides, anilides and esters, as illustrated by Butler et al UK Patent 988,052.

E The emulsions can be protected from fog and desensitization caused by trace amounts of metals such as copper, lead, tin, iron and the like, by incorporating addenda, such as sulfocatechol-type compounds, as illustrated by Kennard et al US Patent 3,236,652; aldolximes, as illustrated by Carroll et al UK Patent 623,448 and meta- and poly-phosphates, as illustrated by Draibach US Patent 2,239,284, and carboxylic acids such as ethylenediamine tetraacetic acid, as illustrated by UK Patent 691,715.

F Among stabilizers useful in layers containing synthetic polymers of the type employed as vehicles and to improve covering power are monohydric and polyhydric phenols, as illustrated by Forsgard US Patent 3,043,697; saccharides, as illustrated by UK Patent 897,497 and Stevens et al UK Patent 1,039,471 and quinolone derivatives, as illustrated by Dersch et al US Patent 3,446,618.

G Among stabilizers useful in protecting the emulsion layers against dichroic fog are addenda, such as salts of nitron, as illustrated by Barbier et al US Patents 3,679,424 and 3,820,998; mercaptocarboxylic acids, as illustrated by Willems et al US Patent 3,600,178, and addenda listed by E J Birr, *Stabilization of Photographic Silver Halide Emulsions*, Focal Press, London, 1974, pp 126-218.

H Among stabilizers useful in protecting emulsion layers against development fog are addenda such as azabenzimidazoles, as illustrated by Bloom et al UK Patent 1,356,142 and US Patent 3,575,699, Rogers US Patent 3,473,924 and Carlson et al Patent 3,649,267; substituted benzimidazoles, benzothiazoles, benzotriazoles and the like, as illustrated by Brooker et al US Patent 2,131,038, Land US Patent 2,704,721, Rogers et al US Patent 3,265,498; mercapto-substituted compounds, eg, mercaptotetrazoles, as illustrated by Dimsdale et al US Patent 2,432,864, Rauch et al US Patent 3,081,170, Weyerts et al US Patent 3,260,597, Grasshoff et al US Patent 3,674,478 and Arond US Patent 3,706,557; isothiourea derivatives, as illustrated by Herz et al US Patent 3,220,839, and thiodiazole derivatives, as illustrated by von Konig US Patent 3,364,028 and von Konig et al UK Patent 1,186,441.

I Where hardeners of the aldehyde type are employed, the emulsion layers can be protected with antifoggants, such as monohydric and polyhydric phenols of the type illustrated by Sheppard et al US Patent 2,165,421; nitro-substituted compounds of the type disclosed by Rees et al UK Patent 1,269,268; poly(alkylene oxides), as illustrated by Valbusa UK Patent 1,151,914, and mucohalogenic acids in combination with urazoles, as illustrated by Allen et al US Patents 3,232,761 and 3,232,764, or further in combination with maleic acid hydrazide, as illustrated by Rees et al US Patent 3,295,980.

J To protect emulsion layers coated on linear polyester supports addenda can be employed such as parabanic acid, hydantoin acid hydrazides and urazoles, as illustrated by Anderson et al US Patent 3,287,135, and piazines containing two symmetrically fused 6-member carbocyclic rings, especially in combination with an aldehyde-type hardening agent, as illustrated in Rees et al US Patent 3,396,023.

K Kink desensitization of the emulsions can be reduced by the incorporation of thallous nitrate, as illustrated by Overman US Patent 2,628,167; compounds, polymeric latices and dispersions of the type disclosed by Jones et al US Patents 2,759,821 and '822; azole and mercaptotetrazole hydrophilic colloid dispersions of the type disclosed by *Research Disclosure*, Vol 116, December 1973, Item 11684; plasticized gelatin compositions of the type disclosed by Milton et al US Patent 3,033,680; water-soluble interpolymers of the type disclosed by Rees et al US Patent 3,536,491; polymeric latices prepared by emulsion polymerization in the presence of poly(alkylene oxide), as disclosed by Pearson et al US Patent 3,772,032, and gelatin graft copolymers of the type disclosed by Rakoczy US Patent 3,837,861.

L Where the photographic element is to be processed at elevated bath or drying temperatures, as in rapid access processors, pressure desensitization and/or increased fog can be controlled by selected combinations of addenda, vehicles, hardeners and/or processing conditions, as illustrated by Abbott et al US Patent 3,295,976, Barnes et al US Patent 3,545,971, Salesin US Patent 3,708,303, Yamamoto et al US Patent 3,615,619, Brown et al US Patent 3,623,873, Taber US Patent 3,671,258, Abele US Patent 3,791,830, *Research Disclosure*, Vol 99, July 1972, Item 9930, Florens et al US Patent 3,843,364, Priem et al US Patent 3,867,152, Adachi et al US Patent 3,967,965 and Mikawa et al US Patents 3,947,274 and 3,954,474.

M In addition to increasing the pH or decreasing the pAg of an emulsion and adding gelatin, which are known to retard latent image fading, latent image stabilizers can be incorporated, such as amino acids, as illustrated by Ezekiel UK Patents 1,335,923, 1,378,354,

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1,387,654 and 1,391,672; Ezekiel et al UK Patent 1,394,371, Jefferson US Patent 3,843,372, Jefferson et al UK Patent 1,412,294 and Thurston UK Patent 1,343,904; carbonylsulfite addition products in combination with hydroxybenzene or aromatic amine developing agents, as illustrated by Seiter et al US Patent 3,424,583; cycloalkyl-1,3-diones, as illustrated by Beckett et al US Patent 3,447,926; enzymes of the catalase type, as illustrated by Matejec et al US Patent 3,600,182; halogen-substituted hardeners in combination with certain cyanine dyes, as illustrated by Kumai et al US Patent 3,881,933; hydrazides, as illustrated by Honig et al US Patent 3,386,831; alkenylbenzothiazolium salts, as illustrated by Arai et al US Patent 3,954,478; hydroxy-substituted benzylidene derivatives, as illustrated by Thurston UK Patent 1,308,777 and Ezekiel et al UK Patents 1,347,544 and 1,353,527; mercapto-substituted compounds of the type disclosed by Sutherns US Patent 3,519,427; metal-organic complexes of the type disclosed by Matejec et al US Patent 3,639,128; penicillin derivatives, as illustrated by Ezekiel UK Patent 1,389,089; propynylthio derivatives of benzimidazoles, pyrimidines, etc. as illustrated by von Konig et al US Patent 3,910,791; combinations of iridium and rhodium compounds, as disclosed by Yamasue et al US Patent 3,901,713; sydnones or sydnone imines, as illustrated by Noda et al US Patent 3,881,939; thiazolidine derivatives, as illustrated by Ezekiel UK Patent 1,458,197 and thioether-substituted imidazoles, as illustrated by *Research Disclosure*, Vol 136, August 1975, Item 13651.

VII Color materials — T E Brei, contributor

A The photographic elements can be color photographic elements which form dye images through the selective destruction, formation or physical removal of dyes.

B The photographic elements can produce dye images through the selective destruction of dyes or dye precursors, such as silver-dye-bleach processes, as illustrated by A Meyer, *The Journal of Photographic Science*, Vol 13, 1965, pp 90-97. Bleachable azo, azoxy, xanthene, azine, phenylmethane, nitroso complex, indigo, quinone, nitro-substituted, phthalocyanine and formazan dyes, as illustrated by Stauner et al US Patent 3,754,923, Piller et al US Patent 3,749,576, Yoshida et al US Patent 3,738,839, Froelich et al US Patent 3,716,368, Piller US Patent 3,655,388, Williams et al US Patent 3,642,482, Gilman US Patent 3,567,448, Loeffel US Patent 3,443,953, Anderau US Patents 3,443,952 and 3,211,556, Mory et al US Patents 3,202,511 and 3,178,291 and Anderau et al US Patents 3,178,285 and 3,178,290, as well as their hydrazo, diazonium and tetrazolium precursors and leuco and shifted derivatives, as illustrated by UK Patents 923,265, 999,996 and 1,042,300, Pelz et al US Patent 3,684,513, Watanabe et al US Patent 3,615,493, Wilson et al US Patent 3,503,741, Boes et al US Patent 3,340,059, Gompf et al US Patent 3,493,372 and Puschel et al US Patent 3,561,970, can be employed.

C The photographic elements can produce dye images through the selective formation of dyes, such as by reacting (coupling) a color-developing agent (eg. a primary aromatic amine) in its oxidized form with a dye-forming coupler. The dye-forming couplers can be incorporated in the photographic elements, as illustrated by Schneider et al, *Die Chemie*, Vol 57, 1944, p 113, Mannes et al US Patent 2,304,940, Martinez US Patent 2,269,158, Jelley et al US Patent 2,322,027, Frolich et al US Patent 2,376,679, Fierke et al US Patent 2,801,171, Smith US Patent 3,748,141, Tong US Patent 2,772,163, Thirtle et al US Patent 2,835,579, Sawdey et al US Patent 2,533,514, Peterson US Patent 2,353,754, Seidel US Patent 3,409,435 and Chen *Research Disclosure*, Vol 159, July 1977, Item 15930.

D In one form the dye-forming couplers are chosen to form subtractive primary (ie. yellow, magenta and cyan) image dyes and are nondiffusible, colorless couplers, such as two and four equivalent couplers of the open chain ketomethylene, pyrazolone, pyrazolo-triazole, pyrazolobenzimidazole, phenol and naphthol type hydrophobically ballasted for incorporation in high-boiling organic (coupler) solvents. Such couplers are illustrated by Salminen et al US Patents 2,423,730, 2,772,162, 2,895,826, 2,710,803, 2,407,207, 3,737,316 and 2,367,531, Loria et al US Patents 2,772,161, 2,600,788, 3,006,759, 3,214,437 and 3,253,924, McCrossen et al US Patent 2,875,057, Bush et al US Patent 2,908,573, Gledhill et al US Patent 3,034,892, Weissberger et al US Patents 2,474,293, 2,407,210, 3,062,653, 3,265,506 and 3,384,657, Porter et al US Patent 2,343,703, Greenhalgh et al US Patent 3,127,269, Feniak et al US Patents 2,865,748, 2,933,391 and 2,865,751, Bailey et al US Patent 3,725,067, Beavers et al US Patent 3,758,308, Lau US Patent 3,779,763, Fernandez US Patent 3,785,829, UK Patent 969,921, UK Patent 1,241,069, UK Patent 1,011,940, Vanden Eynde et al US Patent 3,762,921, Beavers US Patent 2,983,608, Loria US Patents 3,311,476, 3,408,194, 3,458,315, 3,447,928, 3,476,563, Cressman et al US Patent 3,419,390, Young US Patent 3,419,391, Lestina US Patent 3,519,429, UK Patent 975,928, UK Patent 1,111,554, Jaeken US Patent 3,222,176 and Canadian Patent 726,651, Schulte et al UK Patent 1,248,924 and Whitmore et al US Patent 3,227,550.

E The photographic elements can incorporate alkali-soluble ballasted couplers, as illustrated by Froelich et al and Tong, cited above. The photographic elements can be adapted to form non-diffusible image dyes using dye-forming couplers in developers, as illustrated by UK Patent 478,984, Yager et al US Patent

3,113,864, Vittum et al US Patents 3,002,836, 2,271,238 and 2,362,598, Schwan et al US Patent 2,950,970, Carroll et al US Patent 2,592,243, Porter et al US Patents 2,343,703, 2,376,380 and 2,369,489, Spath UK Patent 886,723 and US Patent 2,899,306, Tuite US Patent 3,152,896 and Mannes et al US Patents 2,115,394, 2,252,718 and 2,108,602.

F The dye-forming couplers upon coupling can release photo-graphically useful fragments, such as development inhibitors or accelerators, bleach accelerators, developing agents, silver halide solvents, toners, hardeners, fogging agents, antifoggants, competing couplers, chemical or spectral sensitizers and desensitizers. Development inhibitor-releasing (DIR) couplers are illustrated by Whitmore et al US Patent 3,148,062, Barr et al US Patent 3,227,554, Barr US Patent 3,733,201, Sawdey US Patent 3,617,291, Groet et al US Patent 3,703,375, Abbott et al US Patent 3,615,506, Weissberger et al US Patent 3,265,506, Seymour US Patent 3,620,745, Marx et al US Patent 3,632,345, Mader et al US Patent 3,869,291, UK Patent 1,201,110, Oishi et al US Patent 3,642,485, Verbrugge UK Patent 1,236,767, Fujiwhara et al US Patent 3,770,436, Matsuo et al US Patent 3,808,945. DIR compounds which do not form dye upon reaction with oxidized color-developing agents can be employed, as illustrated by Fujiwhara et al German OLS 2,529,350 and US Patents 3,928,041, 3,958,993 and 3,961,959, Odenwalder et al German OLS 2,448,063, Tanaka et al German OLS 2,610,546, Kikuchi et al US Patent 4,049,455 and Credner et al US Patent 4,052,213. DIR compounds which oxidatively cleave can be employed, as illustrated by Porter et al US Patent 3,379,529, Green et al US Patent 3,043,690, Barr US Patent 3,364,022, Duenneier et al US Patent 3,297,445 and Rees et al US Patent 3,287,129.

G The photographic elements can incorporate colored dye-forming couplers, such as those employed to form integral masks for negative color images, as illustrated by Hanson US Patent 2,449,966, Glass et al US Patent 2,521,908, Gledhill et al US Patent 3,034,892, Loria US Patent 3,476,563, Lestina US Patent 3,519,429, Friedman US Patent 2,543,691, Puschel et al US Patent 3,028,238, Menzel et al US Patent 3,061,432 and Greenhalgh UK Patent 1,035,959, and/or competing couplers, as illustrated by Murin et al US Patent 3,876,428, Sakamoto et al US Patent 3,580,722, Puschel US Patent 2,998,314, Whitmore US Patent 2,808,329, Salminen US Patent 2,742,832 and Weller et al US Patent 2,689,793.

H The photographic elements can produce dye images through the selective removal of dyes. Negative or positive dye images can be produced by the immobilization or mobilization of incorporated color-providing substances as a function of exposure and development, as illustrated by UK Patents, 1,456,413, 1,479,739, 1,475,265 and 1,471,752, Friedman US Patent 2,543,691, Whitmore US Patent 3,227,552, Bloom et al US Patent 3,443,940, Morse US Patent 3,549,364, Cook US Patent 3,620,730, Danhauser US Patent 3,730,718, Staples US Patent 3,923,510, Oishi et al US Patent 4,052,214 and Fleckenstein et al US Patent 4,076,529.

I The photographic elements can contain antistain agents (ie, oxidized developing agent scavengers) to prevent developing agents oxidized in one dye image layer unit from migrating to an adjacent dye image layer unit. Such antistain agents include ballasted or otherwise non-diffusing antioxidants, as illustrated by Weissberger et al US Patent 2,336,327, Loria et al US Patent 2,728,659, Vittum et al US Patent 2,360,290, Jelley et al US Patent 2,403,721 and Thirtle et al US Patent 2,701,197. To avoid autooxidation the antistain agents can be employed in combination with other antioxidants, as illustrated by Knechel et al US Patent 3,700,453.

J The photographic elements can include image dye stabilizers. Such image dye stabilizers are illustrated by UK Patent 1,326,889, Lestina et al US Patent 3,432,300 and 3,698,909, Stern et al US Patent 3,574,627, Brannock et al US Patent 3,573,050, Arai et al US Patent 3,764,337 and Smith et al US Patent 4,042,394.

VIII Absorbing and scattering materials — J V Holtzclaw, contributor

A Incident and reflected radiation can be absorbed or scattered by incorporating materials for that purpose in the photographic element layers. Reflective or absorbing materials incorporated directly in the silver halide emulsion layers can increase speed or sharpness. Filter materials, typically located in overcoat and interlayers, can trim spectrally or attenuate incident radiation and antihalation materials, typically located in undercoat and backing layers, can eliminate or diminish reflection (halation) exposure of emulsion layers.

B The reflective materials in the silver halide emulsion layers can include pigments of high refractive index, as illustrated by Marriage UK Patent 504,283 and Yutzy et al UK Patent 760,775; reflecting undercoat layers containing silver halide, as illustrated by Russell US Patent 3,140,179, or silver halide grains sized to optimize scattering, as illustrated by Locker US Patent 3,989,527.

C The absorbing materials can include sensitizing dye absorbed on internal latent image silver halide grains, as illustrated by Fierke et al US Patent 2,947,628; colored pigments, as illustrated by Jelley et al US Patent 2,697,037; colloidal silver (eg, Carey Lea Silver widely used as a blue filter); super fine silver halide used to improve sharpness, as illustrated by UK Patent 1,342,687; finely

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divided carbon used to improve sharpness or for antihalation protection, as illustrated by Simmons US Patent 2,327,828; filter and antihalation dyes, such as the pyrazolone oxonol dyes of Gaspar US Patent 2,274,782, the solubilized diaryl azo dyes of Van Campen US Patent 2,956,879, the solubilized styryl and butadienyl dyes of Heseltine et al US Patents 3,423,207 and 3,384,487, the merocyanine dyes of Silberstein et al US Patent 2,527,583, the merocyanine and oxonol dyes of Oliver US Patents 3,486,897 and 3,652,284 and Oliver et al US Patent 3,718,472 and the enamino hemioxonol dyes of Brooker et al US Patent 3,976,661 and ultraviolet absorbers, such as the cyanomethyl sulfone-derived merocyanines of Oliver US Patent 3,723,154, the thiazolidones, benzotriazoles and thiazolothiazoles of Sawdey US Patents 2,739,888, 3,253,921 and 3,250,617 and Sawdey et al US Patent 2,739,971, the triazoles of Heller et al US Patent 3,004,896 and the hemioxonols of Wahl et al US Patent 3,125,597 and Weber et al US Patent 4,045,229. The dyes and ultraviolet absorbers can be mordanted, as illustrated by Jones et al US Patent 3,282,699 and Heseltine et al US Patents 3,455,693 and 3,438,779.

D The materials can be discharged (ie, decolorized or solubilized) in photographic processing solutions (eg, alkaline, bleaching and/or fixing solutions) or by alkaline vapor, heat or light processing, as illustrated by Altman US Patent 3,269,839, Mitchell US Patent 3,619,194, Wiese et al US Patent 3,769,019, Heseltine et al US Patent 3,745,009 (Reissue 29,168), and Sturmer US Patent 3,984,248.

IX Vehicles and vehicle extenders — J W Carpenter, contributor

A Photographic silver halide emulsion layers and other layers on photographic elements can contain various colloids alone or in combination as vehicles. Suitable hydrophilic materials include both naturally occurring substances such as proteins, protein derivatives, cellulose derivatives — eg, cellulose esters, gelatin — eg, alkali-treated gelatin (cattle bone or hide gelatin) or acid-treated gelatin (pigskin gelatin), gelatin derivatives — eg, acetylated gelatin, phthalated gelatin and the like, polysaccharides such as dextran, gum arabic, zein, casein, pectin, collagen derivatives, collodion, agar-agar, arrowroot, albumin and the like as described in Yutzy et al US Patents 2,614,928 and '929, Lowe et al US Patents 2,691,582, 2,614,930, '931, 2,327,808 and 2,448,534, Gates et al US Patents 2,787,545 and 2,956,880, Himmelmann et al US Patent 3,061,436, Farrell et al US Patent 2,816,027, Ryan US Patents 3,132,945, 3,138,461 and 3,186,846, Dersch et al UK Patent 1,167,159 and US Patents 2,960,405 and 3,436,220, Geary US Patent 3,486,896, Gazzard UK Patent 793,549, Gates et al US Patents 2,992,213, 3,157,506, 3,184,312 and 3,539,353, Miller et al US Patent 3,227,571, Boyer et al US Patent 3,532,502, Malan US Patent 3,551,151, Lohmer et al US Patent 4,018,609, Luciani et al UK Patent 1,186,790, UK Patent 1,489,080 and Hori et al Belgian Patent 856,631, UK Patent 1,490,644, UK Patent 1,483,551, Arase et al UK Patent 1,459,906, Salo US Patents 2,110,491 and 2,311,086, Fallesen US Patent 2,343,650, Yutzy US Patent 2,322,085, Lowe US Patent 2,563,791, Talbot et al US Patent 2,725,293, Hilborn US Patent 2,748,022, DePauw et al US Patent 2,956,883, Ritchie UK Patent 2,095, DeStubner US Patent 1,752,069, Sheppard et al US Patent 2,127,573, Lieng US Patent 2,256,720, Gaspar US Patent 2,361,936, Farmer UK Patent 15,727, Stevens UK Patent 1,062,116 and Yamamoto et al US Patent 3,923,517.

B Photographic emulsion layers and other layers of photographic elements such as overcoat layers, interlayers and subbing layers as well as receiving layers in image transfer elements can also contain alone or in combination with hydrophilic water permeable colloids as vehicles or vehicle extenders (eg, in the form of latices), synthetic polymeric peptizers, carriers and/or binders such as poly(vinyl lactams), acrylamide polymers, polyvinyl alcohol and its derivatives, polyvinyl acetals, polymers of alkyl and sulfoalkyl acrylates and methacrylates, hydrolyzed polyvinyl acetates, polyamides, polyvinyl pyridine, acrylic acid polymers, maleic anhydride copolymers, polyalkylene oxides, methacrylamide copolymers, polyvinyl oxazolidinones, maleic acid copolymers, vinylamine copolymers, methacrylic acid copolymers, acryloyloxyalkylsulfonic acid copolymers, sulfoalkylacrylamide copolymers, polyalkyleneimine copolymers, polyamines, N,N-dialkylaminoalkyl acrylates, vinyl imidazole copolymers, vinyl sulfide copolymers, halogenated styrene polymers, amineacrylamide polymers, polypeptides and the like as described in Hollister et al US Patents 3,679,425, 3,706,564 and 3,813,251, Lowe US Patents 2,253,078, 2,276,322, '323, 2,281,703, 2,311,058 and 2,414,207, Lowe et al US Patents 2,484,456, 2,541,474 and 2,632,704, Perry et al US Patent 3,425,836, Smith et al US Patents 3,415,653 and 3,615,624, Smith US Patent 3,488,708, Whiteley et al US Patents 3,392,025 and 3,511,818, Fitzgerald US Patents 3,681,079, 3,721,565, 3,852,073, 3,861,918 and 3,925,083, Fitzgerald et al US Patent 3,879,205, Nottorf US Patent 3,142,568, Houck et al US Patents 3,062,674 and 3,220,844, Dann et al US Patent 2,882,161, Schupp US Patent 2,579,016, Weaver US Patent 2,829,053, Alles et al US Patent 2,698,240, Priest et al US Patent 3,003,879, Merrill et al US Patent 3,419,397, Stonham US Patent 3,284,207, Lohmer et al US Patent 3,167,430, Williams US Patent 2,957,767, Dawson et al US Patent 2,893,867, Smith et al US Patents

2,860,986 and 2,904,539, Ponticello et al US Patents 3,929,482 and 3,860,428, Ponticello US Patent 3,939,130, Dykstra US Patent 3,411,911 and Dykstra et al Canadian Patent 774,054, Ream et al US Patent 3,287,289, Smith UK Patent 1,466,600, Stevens UK Patent 1,062,116, Fordyce US Patent 2,211,323, Martinez US Patent 2,284,877, Watkins US Patent 2,420,455, Jones US Patent 2,533,166, Bolton US Patent 2,495,918, Graves US Patent 2,289,775, Yackel US Patent 2,565,418, Unruh et al US Patents 2,865,893 and 2,875,059, Rees et al US Patent 3,536,491, Broadhead et al UK Patent 1,348,815, Taylor et al US Patent 3,479,186, Merrill et al US Patent 3,520,857, Bacon et al US Patent 3,690,888, Bowman US Patent 3,748,143, Dickinson et al UK Patents 808,227 and '228, Wood UK Patent 822,192 and Iguchi et al UK Patent 1,398,055.

X Hardeners — M L Davis, contributor

A The layers of the photographic element containing crosslinkable colloids, particularly the gelatin-containing layers, can be hardened by various organic and inorganic hardeners, such as those described in T H James, *The Theory of the Photographic Process*, 4th Ed, MacMillan, 1977, pp 77-87. The hardeners can be used alone or in combination and in free or in blocked form.

B Typical useful hardeners include formaldehyde and free dialdehydes, such as succinaldehyde and glutaraldehyde, as illustrated by Allen et al US Patent 3,232,764; blocked dialdehydes, as illustrated by Kaszuba US Patent 2,586,168, Jeffreys US Patent 2,870,013, and Yamamoto et al US Patent 3,819,608; α -diketones, as illustrated by Allen et al US Patent 2,725,305; active esters of the type described by Burness et al US Patent 3,542,558; sulfonate esters, as illustrated by Allen et al US Patents 2,725,305 and 2,726,162; active halogen compounds, as illustrated by Burness US Patent 3,106,468, Silverman et al US Patent 3,839,042, Ballantine et al US Patent 3,951,940 and Himmelmann et al US Patent 3,174,861; s-triazines and diazines, as illustrated by Yamamoto et al US Patent 3,325,287, Anderau et al US Patent 3,288,775 and Stauner et al US Patent 3,992,366; epoxides, as illustrated by Allen et al US Patent 3,047,394, Burness US Patent 3,189,459 and Birr et al German Patent 1,085,663; aziridines, as illustrated by Allen et al US Patent 2,950,197, Burness et al US Patent 3,271,175 and Sato et al US Patent 3,575,705; active olefins having two or more active bonds, as illustrated by Burness et al US Patents 3,490,911, 3,539,644 and 3,841,872 (Reissue 29,305), Cohen US Patent 3,640,720, Kleist et al German Patent 872,153 and Allen US Patent 2,992,109; blocked active olefins, as illustrated by Burness et al US Patent 3,360,372 and Wilson US Patent 3,345,177; carbodiimides, as illustrated by Blout et al German Patent 1,148,446; isoxazolium salts unsubstituted in the 3-position, as illustrated by Burness et al US Patent 3,321,313; esters of 2-alkoxy-N-carboxyhydroquinoline, as illustrated by Berghaller et al US Patent 4,013,468; N-carbamoyl and N-carbamoyloxypyridinium salts, as illustrated by Himmelmann US Patent 3,880,665; hardeners of mixed function, such as halogen-substituted aldehyde acids (eg, mucochloric and mucobromic acids), as illustrated by White US Patent 2,080,019; onium substituted acroleins, as illustrated by Tschopp et al US Patent 3,792,021, and vinyl sulfones containing other hardening functional groups, as illustrated by Sera et al US Patent 4,028,320; and polymeric hardeners, such as dialdehyde starches, as illustrated by Jeffreys et al US Patent 3,057,723, and copoly(acrolein-methacrylic acid), as illustrated by Himmelmann et al US Patent 3,396,029.

C The use of hardeners in combination is illustrated by Sieg et al US Patent 3,497,358, Dallon et al US Patent 3,832,181 and 3,840,370 and Yamamoto et al US Patent 3,898,089. Hardening accelerators can be used, as illustrated by Sheppard et al US Patent 2,165,421, Kleist German Patent 881,444, Riebel et al US Patent 3,628,961 and Ugi et al US Patent 3,901,708.

XI Coating aids — J W Carpenter, contributor

A The photographic element layers can contain various types of coating aids (eg, wetting agents), such as anionic, cationic, nonionic or zwitterionic surfactants, alone or in combination. Some useful coating aids are saponin; alkylamine oxides as described in Knox US Patent 3,607,291; sulfonated alkylaryl-polyethers as illustrated by Baldisieen US Patent 2,600,831, Knox et al US Patents 2,719,087 and 3,026,202 and Nishio et al US Patent 3,415,649; alkylene glycol ethers of polyhydric alcohols as disclosed by Swan et al US Patent 2,240,469, Swan US Patent 2,240,472, Knox et al US Patent 2,831,766, Seidel et al US Patent 3,409,435, Eiseaman et al US Patent 3,442,654, Knox US Patent 3,514,293, Padday US Patent 3,516,844, Gantz et al US Patent 3,617,292, Wagner et al Patent 774,806, UK Patent 1,022,878 and Milton UK Patent 1,201,054; amphoteric compounds as described in McQueen US Patent 2,197,809, Chilton US Patent 2,368,287, Gates US Patent 2,824,015, Swan US Patent 2,240,471, Knox et al US Patents 2,992,108, 3,091,623, 3,169,870 and 3,306,749, Harriman US Patent 3,018,178, Ben-Ezra US Patent 3,133,816, Wolf et al US Patent 3,408,193, Nishio et al US Patents 3,441,413 and 3,545,974, Sato et al

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US Patent 3,475,174, Knox US Patent 3,506,449, Gantz et al US Patent 3,563,756, Kalenda US Patent 3,573,049, Mackey US Patent 3,619,199, Yamamoto et al US Patents 3,726,683 and 3,843,368; carboxyalkyl substituted polyglycol ethers and esters as described in Ville et al US Patent 3,663,229; various types of monoesters derived from polyhydroxy compounds as disclosed in Boomer US Patent 2,190,645, Swan US Patent 2,240,470, Simmons US Patent 2,240,475, Swan et al US Patent 2,353,279, Knox et al US Patent 3,220,847, Hagge et al US Patent 3,516,833 and UK Patent 1,012,495; fluoro-substituted compounds as illustrated by McDowell US Patent 3,589,906, Groh et al US Patent 3,666,478, Babbitt et al US Patent 3,775,126, Bailey et al US Patent 3,850,642, Habu et al German OLS 2,610,485, UK Patent 1,439,402 and Cruikshank et al *Research Disclosure*, Vol 166, February 1978, Item 16630; imidazoles as illustrated by Mackey US Patent 2,982,651 and Knox US Patent 3,539,352; maleopimarates, optionally in combination with an acetylenic ethylene oxide derivative or a sucrose ester of an aliphatic acid, as disclosed in Knox et al US Patent 2,823,123, Wilson et al US Patent 3,041,171 and Knox US Patents 3,437,485 and 3,564,576; the sodium salt of the condensation product of naphthalene sulfonic acid and formaldehyde as illustrated in Salminen et al US Patent 3,062,649; phosphate esters of glycidol polyethers as disclosed in Mackey US Patent 3,725,079; poly(dimethylsiloxane) as described in Hughes et al US Patent 3,885,965; long chain sucrose ethers or urethanes as illustrated by Nishio et al US Patent 3,507,660; higher alcohol sulfates, water soluble (sulfo) salts of the aliphatic esters of sulfosuccinic acid, fatty acid esters of hydroxyalkyl sulfonic acid, amide and ester derivatives of sulfoacetic acid, alpha-sulfo lower alkyl esters of 7 to 17 carbon atom fatty acids and sulfate ester products of a glycidol polyether as described in Baldsiefen US Patent 2,203,768, Simmons et al US Patent 2,240,476, Harsh et al US Patent 2,447,462, Knox et al US Patents 3,068,101 and 3,201,252, Mackey et al US Patent 3,516,835, Mackey US Patent 3,725,080, Pollet et al US Patent 3,793,032, Ishihara et al US Patent 3,824,102 and *Research Disclosure*, Vol 160, August 1977, Item 16040; sulfoxides as described by Herz *Research Disclosure*, Vol 129, September 1975, Item 12927; taurines as disclosed by Knox et al US Patents 2,739,891 and 3,165,409 and Ben-Ezra US Patent 3,042,522. These and other suitable coating aids are disclosed in *McCutcheon's Detergents and Emulsifiers*, Allured Publishing Corp., 1973.

XII Plasticizers and lubricants — J W Carpenter, contributor

A The flexibility of the silver halide emulsion and other hydrophilic colloid-containing layers of the elements upon drying can be improved through the incorporation of plasticizers. Representative plasticizers include alcohols, dihydric alcohols, trihydric alcohols and polyhydric alcohols, acid amides, cellulose derivatives, lipophilic couplers, esters, phosphate esters such as tricresyl phosphate, glycol esters, diethylene glycol mixed esters, phthalate esters such as dibutyl phthalate and butyl stearate, tetraethylene glycol dimethyl ether, lactams, lower alkyl esters of ethylene bis-glycolic acid, ether esters or diesters of an alkylene glycol or a polyalkylene glycol, polyacrylic acid esters, polyethylene imines, poly(vinyl acetate) and polyurethanes, as illustrated by Eastman et al US Patent 306,470, Wiest US Patent 3,635,853, Milton et al US Patent 2,960,404, Faber et al US Patent 3,412,159, Ishihara et al US Patent 3,640,721, Illingsworth et al US Patent 3,003,878, Lowe et al US Patent 3,237,808, Umberger US Patent 3,361,565, Gray US Patent 2,865,792, Milton US Patents 2,904,434 and 2,860,980, Milton et al US Patent 3,033,680, Dersch et al US Patent 3,173,790, Fowler US Patent 2,772,166 and Fowler et al US Patent 2,835,582, Van Paesschen et al US Patent 3,397,988, Balle et al US Patent 3,791,857, Jones et al US Patent 2,759,821 and Ream et al US Patent 3,287,289.

B The photographic elements can contain lubricants to reduce sliding friction encountered in use. Representative lubricants which can be used in photographic elements include long chain fatty acids, alkali salts of sulfonated castor oil, alkaline earth metal salts of higher aliphatic carboxylic acids, monohydric and dihydric alcohols, ethers, primary amides, hydroxyalkyl amine fatty acid condensates, esters, polyesters, sperm oil products, polysaccharide derivatives, polytetrafluoroethylene particles, silicone derivatives, polymeric silicone compounds plus β -alanine derivative surfactants, mixtures of an alkyl silicone and an aryl-silicone, phosphate triesters, alkali metal salts of alkylphosphoric acid esters, poly(methyl methacrylate) beads, betaines, acyl alkyl taurines and paraffins and waxes, such as carnauba wax, as illustrated by Guestaux et al US Patents 3,082,087 and 3,658,573, Robijns US Patent 2,588,765, Nellist et al US Patent 1,263,722, Harriman US Patent 3,018,178, Brown et al UK Patents 1,320,564 and 1,320,757, Duane US Patent 3,121,060, DeBoer et al *Research Disclosure*, Vol 139, November 1975, Item 13969, Mackey et al US Patent 3,870,521, Stephens US Patent 3,679,411, McGraw US Patent 3,489,567, Ben-Ezra US Patent 3,042,522, UK Patent 955,061, Tallet et al US Patent 3,080,317, Earhart et al US Patent 3,516,832, Knox et al US Patent 2,739,891, Secrist et al US Patent 3,295,979, Nadeau et al US Patent 3,222,178 and Guestaux French Patent 2,180,465.

XIII Antistatic layers

A The photographic elements can contain conducting layers, such as antistatic layers. Such layers can contain soluble salts, such as chloride, nitrate and similar water soluble salts; conductive metals, such as evaporated metals; conductive carbon, as illustrated by Simmons US Patent 3,327,828; insoluble inorganic salts, such as those described by Trevoys US Patents 3,245,833 and 3,428,451; and polymers having ionic groups, as illustrated by Minsk US Patent 2,861,056, Sterman et al US Patent 3,206,312, Babbitt et al US Patent 3,775,126, Trevoys US Patents 3,963,498, 4,025,342, 4,025,463, 4,025,691 and 4,025,704, Smith UK Patent 1,466,600, Kelley et al *Research Disclosure*, Vol 158, June 1977, Item 15840, Campbell et al *Research Disclosure*, Vol 162, October 1977, Item 16258, and Mecca *Research Disclosure*, Vol 166, February 1978, Item 16630.

XIV Methods of addition — J W Carpenter, contributor

A The sensitizing dyes and other addenda incorporated into the layers of the photographic elements can be dissolved and added prior to coating either from water or organic solvent solutions, depending upon the solubility of the addenda. Ultra-sound can be employed to dissolve addenda, as illustrated by Owen et al US Patent 3,485,634 and Salminen US Patent 3,551,157. Semipermeable and ion exchange membranes can be used to introduce addenda, such as water soluble ions (eg, chemical sensitizers). Hydrophobic addenda, particularly those which need not be adsorbed to the silver halide grain surfaces to be effective, such as couplers, redox dye-releasers and the like, can be mechanically dispersed directly, as illustrated by Belgian Patent 852,138, or in high boiling (coupler) solvents, as illustrated by Jelley et al US Patent 3,322,027 and Fierke et al US Patent 2,801,171, or the hydrophobic addenda can be loaded into latices and dispersed, as illustrated by Chen *Research Disclosure*, Vol 159, July 1977, Item 15930.

B Exemplary apparatus and procedures for introducing and blending addenda are illustrated by Johnson et al US Patents 3,425,835, 3,570,818, 3,773,302 and 3,850,643, McCrossen et al US Patent 3,342,605, Collins et al US Patent 2,912,343 and Terwilliger et al US Patents 3,827,888 and 3,888,465.

XV Coating and drying procedures — J M Dieterle and E W Barbee, contributors

A In forming photographic elements the layers can be located on photographic supports by various procedures, including immersion or dip coating, roller coating, reverse roll coating, air knife coating, doctor blade coating, gravure coating, spray coating, extrusion coating, bead coating, stretch-flow coating and curtain coating. High speed coating using a pressure differential is illustrated by Beguin US Patent 2,681,294. Controlled variation in the pressure differential to facilitate coating starts is illustrated by Johnson US Patent 3,220,877 and to minimize splicing disruptions is illustrated by Fowble US Patent 3,916,043. Coating at reduced pressures to accelerate drying is illustrated by Beck US Patent 2,815,307. Very high speed curtain coating is illustrated by Greiller US Patent 3,632,374. Two or more layers can be coated simultaneously, as illustrated by Russell US Patent 2,761,791, Wynn US Patent 2,941,898, Miller et al US Patent 3,206,323, Bacon et al US Patent 3,425,857, Hughes US Patent 3,508,947, Herzhoff et al UK Patent 1,208,809, Herzhoff et al US Patent 3,645,773 and Dittman et al US Patent 4,001,024. In simultaneous multilayer coating varied coating hoppers can be used, as illustrated by Russell et al US Patent 2,761,417, Russell US Patents 2,761,418 and 3,474,758, Mercier et al US Patent 2,761,419, Wright US Patent 2,975,754, Padday US Patent 3,005,440, Mercier US Patent 3,627,564, Timson US Patents 3,749,053 and 3,958,532, Jackson US Patent 3,993,019 and Jackson et al US Patent 3,996,885. Silver halide layers can also be coated by vacuum evaporation, as illustrated by Lu Valle et al US Patents 3,219,444 and 3,219,451.

B The coated layers of the photographic elements can be dried by liquid medium evaporation, typically accelerated by conduction, convection and/or radiation heating. The coated layers can be heated through the support, such as by contacting the support with a heated drum or rollers, or by direct contact with a gaseous medium, such as warm air, as illustrated by Van Derhoeve et al US Patent 2,269,169, Rose US Patent 2,620,285 and Ruff German OLS 2,703,776. Jet impingement of the coated layers with a gaseous medium, usually serving both the purposes of heat and mass transfer — eg, removal of evaporated solvents, is illustrated by Willis US Patent 1,951,004, Allander et al US Patent 3,012,335, Meier-Windhorst US Patent 3,041,739, Stelling US Patent 3,074,179, Darcy et al US Patent 3,599,341 and Stibbe US Patent 4,116,620. Radiation to which the elements are relatively insensitive photographically can be used for heating, such as, within the electromagnetic spectrum, infrared heating, as illustrated by Beck US Patents 2,815,307 and 2,898,882, and

microwave heating, as illustrated by Dippel et al US Patent 2,588,218, Cunningham et al US Patent 2,662,302, Bleackley US Patent 3,466,415, Hering US Patent 3,589,022, Stephansen US Patent 3,672,066, Philips UK Patent 633,731 and Kuroki et al UK Patent 1,207,222.

XVI Matting agents — J W Carpenter, contributor

A The layers of the photographic elements can contain matting agents. Finely divided inorganic particles, such as various forms of silica, barium and calcium sulfates, zinc and titanium oxides, desensitized silver halide and zinc carbonate, dispersed in natural and synthetic vehicles can be employed, as illustrated by Robijns US Patent 2,192,241, Maynard et al US Patent 1,201,905, de Haes US Patent 3,257,206 Nadeau US Patent 3,437,484, Himmelmann et al US Patent 3,322,555, Whitmore et al US Patent 3,411,907, Moede US Patent 3,353,958, Hasenauer et al US Patent 3,370,951, Takenaka et al US Patent 3,615,554, UK Patent 1,260,772, Oshibuchi et al US Patent 3,635,714, Verburg US Patent 3,769,020, Secrist et al US Patent 4,029,504, Nagatomo et al US Patent 4,021,245 and German OLS 2,529,321, Yutzky et al UK Patent 760,775, Byerley et al US Patent 3,523,022 and Salminen et al US Patent 3,062,649.

B Finely divided organic particles or beads can be similarly used as matting agents, such as calcium organic salts, starches — including starch esters, flours, arrowroot, india rubber, talc, hardened deionized or deashed gelatin, zein and polymeric materials — including various forms of cellulose and polymers of α , β -ethylenically unsaturated mono- and di-carboxylic acids, esters and half-esters and their sulfonic acid analogues (particularly acrylic and methacrylic acids and their methyl esters), styrene, acrylonitrile and fluorinated ethylenes as well as polycarbonate and poly(vinyl alcohol), as illustrated by Jelley US Patent 1,939,213, Knoefel US Patents 2,221,873 and 2,268,662, Lindquist US Patent 2,322,037, Plakunov US Patent 3,591,379, Potter et al US Patent 2,376,005, Jelley et al US Patent 2,992,101, Minsk et al US Patent 2,391,181, Lynn US Patent 2,701,245, Earhart et al US Patent 3,516,832, Morcher et al US Patent 3,079,257, Grabhofer et al US Patent 3,443,946, Klockgether et al US Patent 3,262,782, UK Patent 1,055,713, De Geest et al US Patent 3,754,924, and Hutton US Patent 3,767,448.

XVII Supports — J M Dieterle, contributor

A The layers of the photographic elements can be coated on a variety of supports. Typical photographic supports include polymeric film, wood fiber — eg, paper, metallic sheet and foil, glass and ceramic supporting elements provided with one or more subbing layers to enhance the adhesive, antistatic, dimensional, abrasive, hardness, frictional, antihalation and/or other properties of the support surface.

B Typical of useful polymeric film supports are films of cellulose nitrate and cellulose esters such as cellulose triacetate and diacetate, polystyrene, polyamides, homo- and co-polymers of vinyl chloride, poly(vinyl acetal), polycarbonate, homo- and co-polymers of olefins, such as polyethylene and polypropylene, and polyesters of dibasic aromatic carboxylic acids with divalent alcohols, such as poly(ethylene terephthalate).

C Typical of useful paper supports are those which are partially acetylated or coated with baryta and/or a polyolefin, particularly a polymer of an α -olefin containing 2 to 10 carbon atoms, such as polyethylene, polypropylene, copolymers of ethylene and propylene and the like.

D Polyolefins, such as polyethylene, polypropylene and polyallomers — eg, copolymers of ethylene with propylene, as illustrated by Hagemeyer et al US Patent 3,478,128, are preferably employed as resin coatings over paper, as illustrated by Crawford et al US Patent 3,411,908 and Joseph et al US Patent 3,630,740, over polystyrene and polyester film supports, as illustrated by Crawford et al US Patent 3,630,742, or can be employed as unitary flexible reflection supports, as illustrated by Venor et al US Patent 3,973,963.

E Preferred cellulose ester supports are cellulose triacetate supports, as illustrated by Fordyce et al US Patent 2,492,977, '978 and 2,739,069, as well as mixed cellulose ester supports, such as cellulose acetate propionate and cellulose acetate butyrate, as illustrated by Fordyce et al US Patent 2,739,070.

F Preferred polyester film supports are comprised of linear polyester, such as illustrated by Alles et al US Patent 2,627,088, Wellman US Patent 2,720,503, Alles US Patent 2,779,684 and Kibler et al US Patent 2,901,466. Polyester films can be formed by varied techniques, as illustrated by Alles, cited above, Czerkas et al US Patent 3,663,683 and Williams et al US Patent 3,504,075, and modified for use as photographic film supports, as illustrated by Van Stappen US Patent 3,227,576, Nadeau et al US Patent 3,501,301, Reedy et al US Patent 3,589,905, Babbitt et al US Patent 3,850,640, Bailey et al US Patent 3,888,678, Hunter US Patent 3,904,420 and Mallinson et al US Patent 3,928,697.

G The photographic elements can employ supports which are

resistant to dimensional change at elevated temperatures. Such supports can be comprised of linear condensation polymers which have glass transition temperatures above about 190°C, preferably 220°C, such as polycarbonates, polycarboxylic esters, polyamides, polysulfonamides, polyethers, polyimides, polysulfonates and copolymer variants, as illustrated by Hamb US Patents 3,634,089 and 3,772,405; Hamb et al US Patents 3,725,070 and 3,793,249; Wilson *Research Disclosure*, Vol 118, February 1974, Item 11833, and Vol 120, April 1974, Item 12046; Conklin et al *Research Disclosure*, Vol 120, April 1974, Item 12012; *Product Licensing Index*, Vol 92, December 1971, Items 9205 and 9207; *Research Disclosure*, Vol 101, September 1972, Items 10119 and 10148; *Research Disclosure*, Vol 106, February 1973, Item 10613; *Research Disclosure*, Vol 117, January 1974, Item 11709, and *Research Disclosure*, Vol 134, June 1975, Item 13455.

XVIII Exposure

A The photographic elements can be imagewise exposed with various forms of energy, which encompass the ultraviolet and visible (eg, actinic) and infrared regions of the electromagnetic spectrum as well as electron beam and beta radiation, gamma ray, x-ray, alpha particle, neutron radiation and other forms of corpuscular and wavelike radiant energy in either noncoherent (random phase) forms or coherent (in phase) forms, as produced by lasers. Exposures can be monochromatic, orthochromatic or panchromatic. Imagewise exposures at ambient, elevated or reduced temperatures and/or pressures, including high or low intensity exposures, continuous or intermittent exposures, exposure times ranging from minutes to relatively short durations in the millisecond to microsecond range and solarizing exposures, can be employed within the useful response ranges determined by conventional sensitometric techniques, as illustrated by T H James, *The Theory of the Photographic Process*, 4th Ed, Macmillan, 1977, Chapters 4, 6, 17, 18 and 23.

XIX Processing — M P Bombard, R T Durbin and T J Huttemann, contributors

A The light-sensitive silver halide contained in the photographic elements can be processed following exposure to form a visible image by associating the silver halide with an aqueous alkaline medium in the presence of a developing agent contained in the medium or the element. Processing formulations and techniques are described in L F Mason, *Photographic Processing Chemistry*, Focal Press, London, 1966; *Processing Chemicals and Formulas*, Publication J-1, Eastman Kodak Company, 1973; *Photo-Lab Index*, Morgan and Morgan, Inc, Dobbs Ferry, New York, 1977, and *Neblette's Handbook of Photography and Reprography — Materials, Processes and Systems*, VanNostrand Reinhold Company, 7th Ed, 1977.

B Included among the processing methods are web processing, as illustrated by Tregillus et al US Patent 3,179,517; stabilization processing, as illustrated by Herz et al US Patent 3,220,839, Cole US Patent 3,615,511, Shipton et al UK Patent 1,258,906 and Haist et al US Patent 3,647,453; monobath processing as described in Haist, *Monobath Manual*, Morgan and Morgan, Inc, 1966, Schuler US Patent 3,240,603, Haist et al US Patents 3,615,513 and 3,628,955 and Price US Patent 3,723,126; infectious development, as illustrated by Milton US Patents 3,294,537, 3,600,174, 3,615,519 and 3,615,524, Whiteley US Patent 3,516,830, Drago US Patent 3,615,488, Salesin et al US Patent 3,625,689, Illingsworth US Patent 3,632,340, Salesin UK Patent 1,273,030 and US Patent 3,708,303; hardening development, as illustrated by Allen et al US Patent 3,232,761; roller transport processing, as illustrated by Russell et al US Patents 3,025,779 and 3,515,556, Masseth US Patent 3,573,914, Taber et al US Patent 3,647,459 and Rees et al UK Patent 1,269,268; alkaline vapor processing, as illustrated by *Product Licensing Index*, Vol 97, May 1972, Item 9711, Goffe et al US Patent 3,816,136 and King US Patent 3,985,564; metal ion development as illustrated by Price, *Photographic Science and Engineering*, Vol 19, Number 5, 1975, pp 283-287 and Vought *Research Disclosure*, Vol 150, October 1976, Item 15034; reversal processing, as illustrated by Henn et al US Patent 3,576,633; and surface application processing, as illustrated by Kitz US Patent 3,418,132.

C The photographic elements can be processed to form dye images which correspond to or are reversals of the silver halide rendered selectively developable by imagewise exposure.

D Multicolor reversal dye images can be formed in photographic elements having differentially spectrally sensitized silver halide layers by black-and-white development followed by i) where the elements lack incorporated dye image formers, sequential reversal color development with developers containing dye image formers, such as color couplers, as illustrated by Mannes et al US Patent 2,252,718, Schwan et al US Patent 2,950,970 and Pilato US Patent 3,547,650; ii) where the elements contain incorporated dye image formers, such as color couplers,

a single color development step, as illustrated by the Kodak Ektachrome E4 and E6 and Agfa processes described in *British Journal of Photography Annual*, 1977, pp 194-197, and *British Journal of Photography*, August 2, 1974, pp 668-669; and iii) where the photographic elements contain bleachable dyes, silver-dye-bleach processing, as illustrated by the Cibachrome P-10 and P-18 processes described in the *British Journal of Photography Annual*, 1977, pp 209-212.

E The photographic elements can be adapted for direct color reversal processing (ie, production of reversal color images without prior black-and-white development), as illustrated by UK Patent 1,075,385, Barr US Patent 3,243,294, Hendess et al US Patent 3,647,452, Puschel et al German Patent 1,257,570 and US Patents 3,457,077 and 3,467,520, Accary-Venet et al UK Patent 1,132,736, Schranz et al German Patent 1,259,700, Marx et al German Patent 1,259,701 and Muller-Bore German OLS 2,005,091.

F Multicolor dye images which correspond to the silver halide rendered selectively developable by imagewise exposure, typically negative dye images can be produced by processing, as illustrated by the Kodacolor C-22, the Kodak Flexicolor C-41 and the Agfacolor processes described in *British Journal of Photography Annual*, 1977, pp 201-205. The photographic elements can also be processed by the Kodak Ektaprint-3 and -300 processes as described in Kodak Color Dataguide, 5th Ed, 1975, pp 18-19, and the Agfacolor process as described in *British Journal of Photography Annual*, 1977, pp 205-206, such processes being particularly suited to processing color print materials, such as resin-coated photographic papers, to form positive dye images.

G The photographic elements can be processed in the presence of reducible species, such as transition metal ion complexes (eg cobalt(III) and ruthenium(III) complexes containing amine and/or ammine ligands) and peroxy compounds (eg hydrogen peroxide and alkali metal perborates and percarbonates).

H Dye images can be formed or amplified by processes which employ in combination with a dye-image-generating reducing agent an inert transition metal ion complex oxidizing agent, as illustrated by Bissonette US Patent 3,748,138, 3,862,652, 3,862,842 and 3,989,526 and Travis US Patent 3,765,891, and/or a peroxide oxidizing agent, as illustrated by Matejec US Patent 3,674,490, *Research Disclosure*, Vol 116, December 1973, Item 11660, and Bissonette *Research Disclosure*, Vol 148, August 1976, Items 14836, 14846 and 14847. The photographic elements can be particularly adapted to form dye images by such processes, as illustrated by Dunn et al US Patent 3,822,129, Bissonette US Patents 3,834,907 and 3,902,905, Bissonette et al US Patent 3,847,619 and Mowrey US Patent 3,904,413.

I The presence of transition metal ion complexes can accelerate silver halide development, as illustrated by Bissonette US Patent 3,748,138, Beavers US Patent 3,901,712 and Price US Patent 3,964,912; can bleach silver images, as illustrated by Bissonette US Patent 3,923,511 and *Research Disclosure*, Item 14846, and can be employed to form tanned colloid images, as illustrated by Bissonette US Patent 3,856,524 and McGuckin US Patent 3,862,855.

J The peroxide oxidizing agents can be employed to form vesicular images, as illustrated by Weyde US Patent 3,615,491, Weyde et al UK Patent 1,329,444 and US Patent 3,765,890, Meyer et al UK Patent 1,332,693, Liebe et al German OLS 2,420,521 and Matejec et al US Patent 3,776,730.

XX Developing agents — R T Durbin, contributor

A The photographic elements can contain organic or inorganic developing agents or mixtures thereof. Representative developing agents are disclosed by T H James, *The Theory of the Photographic Process*, 4th Ed, Macmillan, 1977, Chapter 11, and the references cited therein. Useful classes of organic developing agents include hydroquinones, catechols, aminophenols, pyrazolidones, phenylenediamines, tetrahydroquinolines, bis(pyridone)amines, cycloalkenones, pyrimidines, reductiones, and coumarins. Useful inorganic developing agents include compounds of a metal having at least two distinct valence states which compounds are capable of reducing ionic silver to metallic silver, such metals include iron, titanium, vanadium and chromium, and the metal compounds employed are typically complexes with organic compounds such as polycarboxylic acids or aminopolycarboxylic acids. Included among useful developing agents are the iodohydroquinones of Duennebier et al US Patent 3,297,445, the amino hydroxy cycloalkenones of Gabrielsen et al US Patent 3,690,872, the 5-hydroxy and 5-amino-pyrimidines of Wyand et al US Patent 3,672,891, the N-acyl derivatives of p-aminophenols of Porter et al UK Patent 1,045,303, the 3-pyrazolidones of Kendall US Patent 2,289,367, Allen US Patent 2,772,282, Stewart et al UK Patent 1,023,701 and DeMarle et al US Patents 3,221,023 and 3,241,967, the anhydro dihydro reductiones of Gabrielsen et al US Patent 3,672,896, and the 6-hydroxy and 6-aminocoumarins of Oftedahl US Patent 3,615,521. Advantageous results can be obtained with combinations of organic and inorganic developing agents as described in Vought *Research Disclosure*, Vol 150, October 1976, Item 15034, and with combinations of different types of organic developing agents such as the combination of anhydrodihydroamino reductiones and aminomethylhydroquinones

of Youngquist US Patent 3,666,457 and the combination of ascorbic acid and 3-pyrazolidone of Sutherns UK Patent 1,281,516. Developing agents can be incorporated in photographic elements in the form of precursors. Examples of such precursors include the halogenated acylhydroquinones of Porter et al US Patent 3,246,988, the N-acyl derivatives of aminophenols of Porter et al US Patent 3,291,609, the reaction products of a catechol or hydroquinone with a metal described in Barr US Patent 3,295,978, the quinhydrone dyes of Haefner et al US Patent 3,565,627, the cyclohex-2-ene-1,4-diones and cyclohex-2-ene-1-one-4-monoketals of Chapman et al US Patent 3,586,506, and the Schiff bases of p-phenylenediamines of Pupo et al *Research Disclosure*, Vol 151, November 1976, Item 15159.

B The developing agents can be present in one or more hydrophilic colloid layers of the photographic element, such as a silver halide emulsion layer or a layer adjacent the silver halide layer, as illustrated by Haefner US Defensive Publication T-882020. The developing agent can be added to the layer in the form of a dispersion with a film-forming polymer in a water immiscible solvent, as illustrated by Dunn et al US Patent 3,518,088, or as a dispersion with a polymer latex, as illustrated by Chen *Research Disclosure*, Vol 159, July 1977, Item 15930, and Pupo et al *Research Disclosure*, Vol 148, August 1976, Item 14850.

XXI Development modifiers — J W Carpenter, contributor

A The photographic elements can contain development modifiers in the silver halide emulsion and other developer permeable layers to either accelerate or restrain development.

B Development accelerators of the poly(alkylene oxide) type are disclosed by Blake et al US Patents 2,400,532 and 2,423,549, Blake US Patent 2,441,389, Chechak et al US Patent 2,848,330, Howe UK Patent 805,827, Piper US Patents 2,886,437 and 3,017,271, Carroll et al US Patents 2,944,900 and 2,944,902, Dersch et al UK Patent 1,030,701 and US Patents 3,006,760, 3,084,044 and 3,255,013, Beavers US Patent 3,039,873, Popeck et al US Patent 3,044,874, Hart et al US Patent 3,150,977, Willems et al US Patent 3,158,484, 3,523,796 and 3,523,797, Beavers et al US Patents 3,253,919 and 3,426,029, Goffe US Patent 3,294,540, Milton US Patent 3,615,519, Grabhofer et al US Patent 3,385,708, Mackey et al US Patents 3,532,501 and 3,597,214, Willems US Patent 3,552,968, Huckstadt et al US Patent 3,558,314, Sato et al US Patent 3,663,230, Yoneyama et al US Patent 3,671,247 and Pollet et al US Patent 3,947,273 and UK Patent 1,455,413.

C Representative development accelerators additionally comprise carboxylic and sulfonic acid compounds and their salts, aliphatic amines, carbamates, adducts of a thioamine with an aldehyde, polyamines, polyamides, polyesters, aminophenols, polyhydroxybenzenes, thioethers and thioamides, poly(vinyl lactams), poly(N-vinyl-2-oxazolidone), protamine sulfate, pyrazolidones, dihydropyridine compounds, hydroxyalkyl ether derivatives of starch, sulfite ester polymers, bis-sulfonyl alkanes, 1,4-thiazines and thiocarbamate, as illustrated by UK Patents 1,019,693 and 1,140,741, Weyerts US Patents 2,367,549 and 2,380,280, Dersch et al US Patent 3,446,618, Mowrey US Patent 3,904,413, Jones et al US Patents 3,128,183 and 3,369,905, Arai et al US Patents 3,782,946, 3,801,323, 3,804,624 and 3,822,130, Nishio et al US Patent 3,163,536, Beavers et al US Patents 3,330,661 and 3,305,363, Willems et al US Patent 3,502,472, Huckstadt et al US Patent 3,617,280, Plakunov et al US Patent 3,708,302, Beavers US Patent 3,046,135, Nakajima et al US Patent 3,429,707, Minsk US Patent 3,046,132 and '133 and Minsk et al US Patent 3,813,247, Rogers et al US Patent 3,192,044, Janssen et al US Patent 3,718,464, Williams et al US Patent 3,021,215, Dann et al US Patents 3,038,805 and 3,046,134, Graham et al US Patent 3,046,129, Thompson US Patent 3,419,392, Lovett et al US Patents 3,057,724 and 3,165,552, Thompson et al US Patent 3,419,393, Motter US Patent 3,506,443, Froehlich US Patent 3,574,709, Sato et al US Patent 3,625,697, Timmerman et al US Patent 3,986,877, DuMunck et al US Patent 3,615,516, Dersch US Patent 3,006,762, Warren US Patent 2,740,713, Hood et al US Patent 2,751,297, Kennard et al US Patents 2,937,090, 3,192,046 and 3,212,899, Munshi et al US Patent 3,893,862, Holt UK Patent 1,352,196, Chiesa et al US Patent 3,068,102 and Stewart et al US Patent 3,625,699.

D Representative development accelerators also comprise cationic compounds, disulfides, imidazole derivatives, inorganic salts, surfactants, thiazolidines and triazoles of the type disclosed by Carroll et al US Patents 2,271,622, 2,275,727 and 2,288,226, Carroll US Patents 2,271,623 and 3,062,645, Allen et al US Patent 2,299,782, Beavers et al US Patents 2,940,851, 2,940,855 and 2,944,898, Burness et al US Patent 3,061,437, Randolph et al UK Patent 1,067,958, Grabhoefer et al US Patent 3,129,100, Burness US Patent 3,189,457, Willems et al US Patent 3,532,499, Huckstadt et al US Patents 3,471,296, 3,551,158, 3,598,590, 3,615,528, 3,622,329 and 3,640,715, Yoneyama et al US Patent 3,772,021, Nishio et al US Patent 3,615,527, Nakajima et al US Patent 4,001,021, Hara et al US Patent 3,808,003, Sainsbury et al US Patent 2,706,157, Beavers

US Patent 3,901,712, Milton UK Patent 1,201,054, Snellman et al US Patent 3,502,473, van Stappen US Patent 3,923,515, Popeck et al US Patent 2,915,395 and Ebato et al US Patent 3,901,709.

E Representative of development restrainers are cationic compounds of the type disclosed by Douglas et al UK Patent 946,476 and Becker US Patent 3,502,467; esters of the type disclosed by Staud US Patent 2,119,724; lactams of the type disclosed by DeMunck et al UK Patent 1,197,306; mercaptans and thiones, as illustrated by UK Patent 854,693, Rogers et al US Patent 3,265,498, Abbott et al US Patent 3,376,310, Greenhalgh et al UK Patent 1,157,502, Grasshoff et al US Patent 3,674,478, Salesin US Patent 3,708,303, Luckey US Patent 3,695,881, Stark et al UK Patent 1,457,664, Ohyama et al US Patent 3,819,379, Bloom et al US Patent 3,856,520 and Taber et al US Patent 3,647,459; polypeptides, as illustrated by Mueller US Patent 2,699,391; poly(alkylene oxide) derivatives of the type disclosed by Blake et al US Patent 2,400,532, Sprung US Patent 3,471,297, Whiteley US Patent 3,516,830 and Milton US Patent 3,567,458; sulfoxides of the type disclosed by Herz *Research Disclosure*, Vol 129, January 1975, Item 12927; thiazoles as disclosed by Graham US Patent 3,342,596 and diazoles, triazoles and imidazoles as disclosed by *Research Disclosure*, Vol 131, March 1975, Item 13118.

XXII Physical development systems — R T Durbin, contributor

A The photographic elements can contain or be processed to contain, as by direct development, an imagewise distribution of a physical development catalyst. The catalyst-containing element can be processed by pre- or post-fixation physical development in the presence of an image-forming material, such as a salt or complex of a heavy metal ion (eg, silver, copper, palladium, tellurium, cobalt, iron and nickel) which reacts with a reducing agent, such as a silver halide developing agent, at the catalyst surface. Either the absorption or solubility of the image-forming material can be altered by physical development. The image-forming material and/or reducing agent can be incorporated in the photographic element, in a separate element associated during processing or, most commonly, in an aqueous processing solution. The processing solution can contain addenda to adjust and buffer pH, ionic surfactants and stabilizers, thickening agents, preservatives, silver halide solvents and other conventional developer addenda.

B Such physical development systems are illustrated by Archambault et al US Patent 3,576,631, Silverman US Patent 3,591,609, Yudelson et al US Patents 3,650,748, 3,719,490 and 3,598,587, Case US Patent 3,512,972, Charles et al US Patent 3,253,923, Wyman US Patent 3,893,857, Lelental *Research Disclosure*, Vol 156, April 1977, Item 15631 and US Patent 3,935,013 and Weyde et al UK Patent 1,125,646, each particularly illustrating heavy metal salts and complexes: Cole US Patent 3,390,998 and Jonker et al US Patent 3,223,525, particularly illustrating processing solutions containing ionic surfactants and stabilizers and Bloom US Patent 3,578,449, particularly illustrating processing solutions containing silver halide solvents. Physical developers which produce dye images can be employed, as illustrated by Gysling et al US Patents 4,042,392 and 4,046,369.

XXIII Image transfer systems — G L Oliver, contributor

A Image transfer systems include colloid transfer systems, as illustrated by Yutzy et al US Patents 2,596,756 and 2,716,059; silver salt diffusion transfer systems, as illustrated by Rott US Patent 2,352,014, Land US Patent 2,543,181, Yackel et al US Patent 3,020,155 and Land US Patent 2,861,885; imbibition transfer systems, as illustrated by Minsk US Patent 2,882,156, and color image transfer systems, as illustrated by *Research Disclosure*, Vol 151, November 1976, Item 15162, and Vol 123, July 1974, Item 12331.

B Color image transfer systems (including emulsion layers, receiving layers, timing layers, acid layers, processing compositions, supports and cover sheets) and the images they produce can be varied by choosing among a variety of features, combinations of which can be used together as desired.

C Film units can be chosen which are either integrally laminated or separated during exposure, processing and/or viewing, as illustrated by Rogers US Patent 2,983,606, Beavers et al US Patent 3,445,228, Whitmore Canadian Patent 674,082, Friedman et al US Patent 3,309,201, Land US Patents 2,543,181, 3,053,659, 3,415,644, 3,415,645 and 3,415,646 and Barr et al UK Patent 1,330,524.

D Positive-working chemistry can be chosen utilizing initially mobile dyes which are immobilized by development, as illustrated by Rogers US Patent 2,983,606, Yutzy US Patent 2,756,142, Lestina et al US Patent 3,880,658, Bush et al US Patent 3,854,945 and Janssens et al US Patent 3,839,035, or initially immobile dyes which are rendered

mobile by development, as illustrated by Hinshaw et al UK Patent 1,464,104 and Fields US Patent 3,980,479; or negative-working imaging chemistry can be chosen utilizing the release of diffusible dyes from an immobile image dye-forming compound as a function of development, as illustrated by Belgian Patent 838,062, Whitmore et al Canadian Patent 602,607, and US Patent 3,227,550, Bloom et al US Patent 3,443,940, Puschel et al US Patents 3,628,952 and 3,844,785, Gompf et al US Patent 3,698,897, Anderson et al US Patent 3,725,062, Becker et al US Patent 3,728,113, Fleckenstein US Patent 4,053,312, Fleckenstein et al US Patent 4,076,529, Melzer et al UK Patent 1,489,695, Degauchi German OLS 2,729,820 and Kestner et al *Research Disclosure*, Vol 151, November 1976, Item 15157.

E Negative-working emulsions can be chosen, including emulsions used with image-reversing techniques, as illustrated by Barr et al US Patent 3,227,551, Danhauser et al US Patent 3,736,136, Whitmore et al UK Patent 904,364 (page 19), Barr et al UK Patent 1,330,524, Wingender et al US Patent 3,925,075, Pfaff US Patents 4,047,952, and '953, and Schwan et al US Patent 3,630,731; direct-positive emulsions can be chosen, including those of the fogged type as disclosed in Leermakers US Patent 2,184,013, Kendal et al US Patent 2,541,472 and Whitmore et al US Patent 3,227,550, and direct reversal emulsions of the unfogged internal latent image-forming type employed with fogging development as disclosed in Whitmore US Patent 3,227,552, Gilman et al US Patent 3,761,267, Evans US Patent 3,923,513 and Klotzer et al US Patent 3,957,488.

F An image to be viewed can be transferred from the image-forming layers. A retained image can be formed for viewing as a concurrently formed complement of the transferred image. Positive transferred images and useful negative retained images can be formed when one of the imaging chemistry and the emulsion is negative-working and the other positive-working; and negative transferred images and positive retained images can be formed when both the imaging chemistry and the emulsion(s) are negative-working or positive-working. Images retained in and transferred from the image-forming layers are illustrated by UK Patent 1,456,413, Friedman US Patent 2,543,691, Bloom et al US Patent 3,443,940, Staples US Patent 3,923,510 and Fleckenstein et al US Patent 4,076,529.

G One-step processing can be employed, as illustrated by UK Patent 1,471,752, Land US Patent 2,543,181, Rogers US Patent 2,983,606 (pod processing), Land US Patent 3,485,628 (soak image-former and laminate to receiver) and Land US Patent 3,907,563 (soak receiver and laminate to image-forming element); or multi-step processing can be employed, as illustrated by Yutzy US Patent 2,756,142, Whitmore et al US Patent 3,227,550 and Faul et al US Patent 3,998,637.

H Preformed reflective layers can be employed as illustrated by Whitmore Canadian Patent 674,082, Beavers US Patent 3,445,228, Land US Patent 2,543,181, 3,415,644, 3,415,645 and 3,415,646, and Barr et al UK Patent 1,330,524; or processing-formed reflective layers can be employed, as illustrated by Land US Patents 2,607,685 and 3,647,437, Rogers US Patent 2,983,606 and Buckler US Patent 3,661,585.

XXIV Dry development systems — J W Carpenter and P W Lauf, contributors

A Silver halide elements can be designed for recording printout images, as illustrated by Fallesen US Patent 2,369,449, and Bacon et al US Patent 3,447,927, direct print images, as illustrated by Hunt US Patent 3,033,682 and McBride US Patent 3,287,137, or for processing by heat, such as those elements containing i) an oxidation-reduction image-forming combination, such as described in Sheppard et al US Patent 1,976,302, Sorensen et al US Patent 3,152,904, Morgan et al US Patent 3,457,075, Sullivan et al US Patent 3,785,830, Evans et al US Patent 3,801,321 and Sullivan US Patent 3,846,136; ii) at least one silver halide developing agent and an alkaline material and/or alkali release material as described in Stewart et al US Patent 3,312,550, Yutzy et al US Patent 3,392,020; or iii) a stabilizer or stabilizer precursor as described in Humphlett et al US Patent 3,301,678, Haist et al US Patent 3,531,285 and Costa et al US Patent 3,874,946. Photothermographic silver halide systems that are useful are also described in greater detail in *Research Disclosure*, Vol 170, June 1978, Item 17029.

XXV Printing and lithography — J J Saturno, contributor

A Silver halide emulsions can be used to make lithographic printing plates, such as by the colloid transfer of undeveloped and unhardened areas of an exposed and developed emulsion to a suitable support, as illustrated by Clark et al US Patent 2,763,553 and Leone et al US Patent 3,464,821; to provide a relief image, such as by tanning gelatin, as illustrated by Woodward US Patent 3,402,045, Spencer US Patent 3,053,658, Bissonette US Patent 3,856,524 or McGuckin US Patent 3,862,855; to prepare a relief printing plate, as illustrated by Baxter et al US Patent 3,271,150, Stachle et al US Patent 3,271,151 or Whiteley

US Patent 3,516,830, to prepare a silver salt diffusion transfer plate, as illustrated by UK Patent 883,846, Hephher et al UK Patent 934,691, Richardson et al US Patent 3,615,437, Martens et al US Patent 3,736,872, or Staehle US Patent 3,971,660 and to prepare an oleophilic gelatin image, as illustrated by Yackel et al US Patent 3,146,104 (Reissue 25,885). Photoresists useful in making lithographic plates are illustrated by Woodward et al US Patent 3,551,150 and Etter et al US Patent 3,620,737. Treatments to render the plate composition more oleophilic are described in Woodward et al US Patent 3,576,634, Nadeau US Patent 3,547,632, Etter et al US Patent 3,650,742 and Kemp US Patent 3,832,175. Useful subbing layers are illustrated by Sieg et al US Patent 3,600,166. Martens et al, cited above, and Staehle, cited above.

B Latent image stability can be improved by employing physical developers, as illustrated by Gracia et al US Patent 3,807,305, or by employing an incorporated oleophilic complex of a silver halide developer, as illustrated by Elins et al US Patent 3,698,901. Developer solvents for processing the exposed plates are illustrated by Abbott et al US Patent 3,600,177.

XXVI Printout — J W Carpenter, contributor

A The silver halide emulsions can be of the printout type — that is, they can produce a visible image by the direct action of light with no subsequent action required. The preferred printout emulsions are characterized by one or a combination of the following features: silver halide grains formed in the presence of metal salts or ions; surface desensitized fogged silver halide grains; halogen acceptors, optionally in combination with aldehydes or development restrainers; gold compounds; acid substituted compounds, especially salt or complex forming dicarboxylic acids and iodide releasing compounds.

B Printout emulsions including one or a combination of these preferred features are illustrated by UK Patent 1,402,794, Bacon US Patents 3,547,647, 3,531,291 and 3,574,625, Farmer UK Patent 15,727, Marten US Patent 439,021, E J Wall, *Photographic Emulsions*, American Photographic Publishing Co, 1929, pp 106-110, Frankenburger et al US Patent 1,738,530, Thompson et al US Patent 2,888,347, van der Meulen et al US Patent 2,933,389, Roth US Patent 3,042,514, Gilman US Patents 3,143,419 and 3,650,758, Berthold German OLS 2,422,320, Farren et al US Patents 3,409,436 and 3,840,372, Meyer US Patents 637,637 and '638, Luttke US Patent 722,238, Schoenfelder US Patent 730,800, Caldwell US Patent 956,567, Fallesen et al US Patents 2,030,860, 2,126,318, '319 and 2,129,207, Urbach US Patent 2,449,153, Mees US Patent 1,503,595, Johnson US Patent 1,582,050, Fallesen US Patent 2,369,449, Colt US Patent 3,418,122, Jouy US Patent 3,511,662, Wise et al US Patent 3,615,618, Ikenoue et al US Patent 3,960,566, Bates et al US Patent 3,844,789, Chateau et al US Patent 3,419,396, Bacon et al US Patent 3,447,927 and Bullock US Patent 1,454,209.

XXVII Direct-print — J W Carpenter, contributor

A The silver halide emulsions can be of the direct-print type — that is, they can form a latent image by high intensity imagewise exposure and produce a visible image by subsequent low intensity exposure. A heat stabilization step can be interposed between the exposure steps.

B Direct-print emulsions can be prepared in the presence of metal ions (eg, tin, lead, copper, cadmium bismuth, magnesium, rhodium or iridium) and/or excess halide ions (ie, bromide, chloride or iodide) and also nitrite ions, as illustrated by UK Patents 971,677 and 1,250,659, Hunt US Patents 3,033,678, 3,033,682, and 3,241,961, Scott US Patents 3,039,871, 3,047,392 and 3,109,737, Byrne US Patent 3,123,474, Fix US Patent 3,178,292, Bigelow US Patents 3,178,293, 3,449,125, 3,573,919 and 3,615,579, Colt US Patent 3,418,122, Sutherns et al UK Patent 1,096,052 and US Patent 3,420,669, Sutherns UK Patents 1,248,242 and '243, Sprung US Patent 3,436,221, Bacon et al US Patents 3,447,927 and 3,690,888, Pestalozzi US Patent 3,501,299 and 3,561,971, Allentoff et al US Patent 3,573,055, Sincius US Patent 3,594,172, Countryman US Patent 3,597,209, Karlson US Patent 3,615,580, Heeks et al Canadian Patent 995,053 and US Patents 3,660,100 and 3,725,073 Moore UK Patent 1,086,384 and Kitze UK Patent 1,250,659.

C Improved photodevelopment characteristics can be obtained by forming the silver halide grains in the presence of silver halide solvents, such as thiocyanate and thioethers, as illustrated by Sutherns UK Patent 1,096,053 and US Patent 3,260,605, McBride US Patents 3,271,157 and 3,582,345, Sincius US Patent 3,507,656, Mason et al UK Patent 1,178,446, Walters et al US Patent 3,782,960 and O'Neill et al UK Patent 1,247,667 or by adding halogen acceptors (eg, heterocyclic mercaptans, thiones, molecular iodine, thiourea, imidazolinethiones, thiosemicarbazides, thiosemi-

carbazones, urazoles, aromatic thiols, thiouracils, thiadiazolidine-2-thiones and thiurazoles) to the emulsions before coating, as illustrated by Jones US Patent 3,364,032, Kitze US Patent 3,241,971, Fix US Patent 3,326,689, Bacon et al US Patent 3,396,017, Heugebaert et al US Patent 3,474,108, Gates et al US Patent 3,641,046, Ikenoue et al US Patent 3,852,071, Van Pee et al UK Patent 1,155,958, Baylis et al UK Patent 1,165,832, Bacon US Patent 3,547,647, Karlson US Patent 3,563,753, McBride US Patent 3,287,137, Hunt US Patent 3,249,440, Krohn et al US Patent 3,615,614, Takei et al US Patent 3,305,365, and Walters et al US Patent 3,849,146.

D The photodeveloped images can be stabilized by adding to the emulsions before coating stabilizers, such as sulfides, disulfides, dithiocarbamates, azaindines plus acid anions, thiazoles, isothiuronium derivatives, secondary, tertiary or quaternized amines and aliphatic hydroxypoly carboxylic acids, as illustrated by Karlson US Patent 3,486,901, Farren et al US Patent 3,409,436, Weber US Patent 3,535,115 and Bigelow US Patents 3,418,131, 3,505,069, 3,597,210 and 3,652,287.

E The direct-print emulsions can be spectrally sensitized, as illustrated by McBride US Patent 3,287,136, Webster et al US Patent 3,630,749, Hunt US Patents 3,183,088 and 3,189,456, Fix et al US Patents 3,367,780 and 3,579,348, Van Pee et al US Patent 3,745,015, Seiter US Patent 3,508,922, Lincoln et al US Patent 3,854,956 and Borginon et al US Patent 4,053,315.

Disclosed by Eastman Kodak Co, Rochester, New York 14650, USA
17643

17613

A silver halide colour photographic material

A silver halide colour photographic material containing a coloured coupler are used for masking purpose.

The photographic material give high density on colour-developing, good stability in the photographic bleach liquid of high pH, and the obtained photographic material is less fog.

Typical coloured coupler used are 1-hydroxy-4-[3-[4-(1-hydroxy-3,6-disulfo-8-acetamido-2-naphthylazo)-phenoxy acetamido] anilino-carboxyloxy]-N-[8-(2,4-di-tert-amylophenoxy) butyl]-2-naphthamide-di-sodium salt [I], and 1-hydroxy-4-[4-[4-(1-hydroxy-3,6-di-sulfo-8-acetamido-2-naphthylazo)-phenoxyacetamido] benzyl-aminocarbonyloxy]-N-[8-(2,4-di-tert-amylophenoxy)-butyl]-2-naphthamide-di-sodium salt [II].

4g pf 1-hydroxy-N-[8-(2,4-di-tert-amylophenoxy) butyl]-2-naphthamide and 4g of [I] were added to a liquid mixture of 4 ml of dibutyl phthalate and 8 ml of ethyl acetate, and the mixture was heated at 60°C to dissolve the couplers completely. The resulting solution was mixed with 2 ml of 10% aqueous solution of gelatin. Then the mixture was emulsified by means of a colloid mill to form a coupler dispersion.

The so formed dispersion was added to 500g of a gelatin emulsion for negative including silver iodobromide (containing 6.0 mole % of silver iodide) and the mixture was coated and dried on a cellulose triacetate film base.

The so obtained sample was image wise exposed and processed at 20°C, for 10 minutes with a colour forming developer.

The so treated sample was subjected to customary stopping and fixing treatments and washed with water for 10 minutes. Then, the sample was bleached at 20°C for 5 minutes with a bleaching liquid.

Then, sample was washed with water for 5 minutes, and subjected to the fixing treatment at 20°C for 5 minutes by employing a fixing liquid.

The so treated sample was tested with respect to photographic characteristics to obtain results shown below.

Fog	: 0.16
Maximum absorption wavelength of mask	: 555 - 570 nm
Maximum density	: 1.20

Disclosed anonymously
17613

17650

Diamond dies

Polycrystalline diamond dies (such as those sold under the trademark COMPAX and described in a report by D G Flom, et al in the January/February 1975 issue of Wire Technology, pp 19-25) are used for drawing metal wire and tubing. It has been found, however, that by treating these dies to ion-implantation with carbon, nitrogen or other suitable material, the working life of these dies can be greatly im-

proved. A suitable technique is described in a paper entitled 'Ion Implantation of Engineering Materials' by G Dearnaley & N E W Hartley given at IPAT 77 Conference, Ion Plating & Allied Techniques, and published in the Proceedings thereof at pp 187-194. The ion implantation treatment appears not only to harden the working surface of the die but also to improve the bond strength between each diamond crystal and the matrix. In drawing stainless steel wire, Compax dies treated by carbon ion implantation have had up to 5 times the life of untreated Compax dies.

Disclosed by BICC Limited.
17650

17651 Manufacture of electrodes

In our British Patent Application to be published on 4 January 1979 with the Serial No 2000191A, we have described a technique for fabrication of copper into various forms that entails the use of an electrode that has a plurality of cathode surfaces substantially separated from one another by insulating material, which may, for example, be an anodic coating on a continuous electrode sheet. We now propose that such an electrode should be made by first anodising the entire area of a sheet of titanium or other suitable metal and subsequently removing the coating from appropriate areas to form the individual cathode surfaces. Removal may be effected by abrasion or other mechanical means or by using an appropriate etching solution after protecting the part of the coating that is to be retained with a suitable resist. The resist can be patterned photographically, using a light-sensitive resist, or by any other appropriate technique.

Disclosed by BICC Limited
17651

17656 Telescoping aspirator for yarn sampling systems

Telescoping aspirators are incorporated in an automatic yarn sampling system to eliminate yarn loops which cause stringup problems when adjacent yarn packages are stripped for analysis. This permits faster, interference-free delivery of samples to the analytical instrument.

One unit of the aspirator system is schematically illustrated (top view) in Figures I-A and I-B. Yarn packages 1 are arrayed, on a buggy, in front of the aspirator panel 2. A 12-package array is shown in Figure II, arranged as viewed from the aspirator panel and identified by a dual alphabetical-numerical package position code. The yarn buggy is positioned precisely in relation to the telescoping aspirators by parking it in a positioning device. The face of the yarn buggy is located parallel to the face of the aspirator panel and about 1-1/2 feet from it but offset to the side to match the half-extended positions of the telescoping aspirators which extend through the panel at an angle of about 60°. The half-extended position of the telescoping aspirator places the inlet directly in front of the yarn package. The full-extended position places the inlet to the side of the yarn package and locks the yarn to the package so that no loops exist to interfere with sampling of adjacent threadlines.

The telescoping aspirator consists of an extendable, rotatable, inner tube 3 (about 11 inches long) whose exposed end is fitted with a ceramic yarn guide; this is positioned within another extendable tube 4 (about 12 inches long) fitted with a handle 5 at its lower end. The outer tube 4 is positioned within a fixed tubular body 6 connected to an aspirator jet 7 and a solenoid-actuated, combination cutter/diverter 8. From the latter the yarn may be sent to waste or be directed through a second aspirator jet 9 to a collecting funnel 10 for transmission to the desired analytical instrument (not shown).

The operator begins stringup at bobbin position 1 (see Figure II) by pulling out inner aspirator tube 3 while twisting it clockwise to a locked position. With the entrance eyelet in front of the package (Figure I-A), the aspirator jet 7 is activated to draw the yarn into the apparatus from whence it is diverted to waste. Then, the operator pulls handle 5 of the outer telescoping tube 4 to extend the inlet nozzle about 12 inches to a position at the side of the yarn package (Figure I-B); this manual step could be programmed for automatic, pneumatic-powered operation. Although jet 7 is still operating, the yarn is not drawn in because the threadline is held to the side of the package. Jet 7 is programmed to be turned off five seconds after having been started. Using a separate aspirator unit for each package, the operator strings up the remaining yarn packages in the same manner, in the order of package 2, 3, . . . 12 (Figure II). The operator begins sampling at package 'A' by energizing aspirator jets 7 and 9 at that position. This causes (1) the telescoping tube 4 to become fully retracted (pneumatically) and (2) the yarn to be drawn into inner tube 3 (now again located in front of the yarn package 1). The yarn is directed through cutter/diverter 8 to the analyzer unit (not shown) through collecting funnel 10 which serves all aspirator units. A yarn detector (not shown) located near the analyzer causes aspirator jets 7 and 9 to be de-energized when yarn has been delivered to the instrument and is therefore being pulled by the instrument at its test speed. This sampling operation is then performed on the remaining

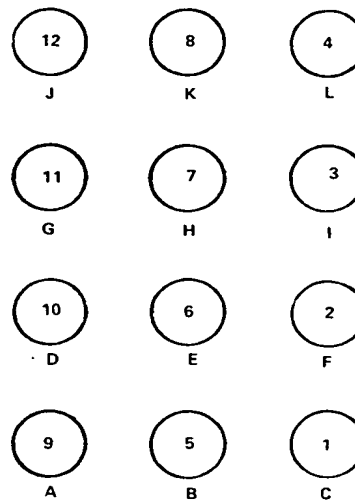
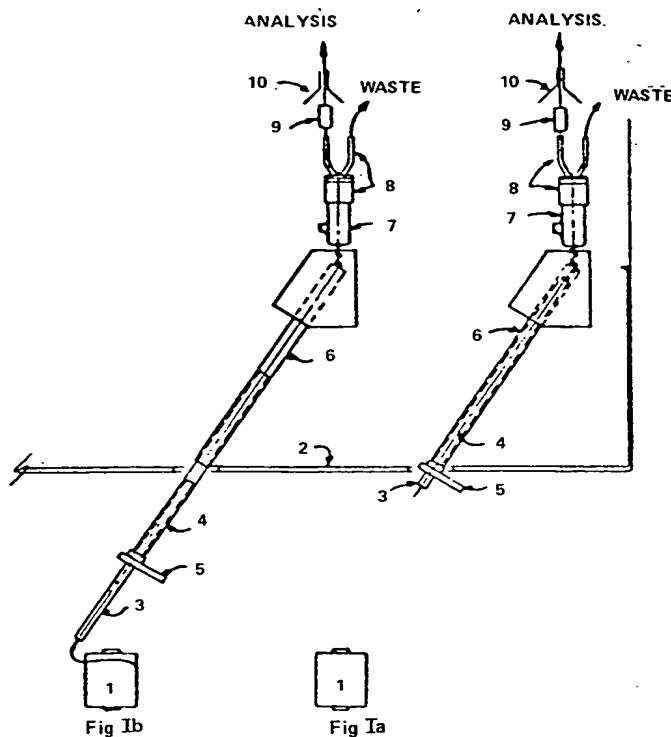


Fig II

packages in the order of 'B', 'C', . . . 'L' (see Figure II). When sampling has been completed, the operator retrieves the loose end of each package from each nozzle and wraps the end around the appropriate package. For each aspirator unit, the operator unlocks inner tube 3 by turning it counter-clockwise and pushes it back into retracted position within the outer tube 4.

The yarn identification (provided on each package) is entered by the operator to a computer to correlate package identification with the results of the analyses.

Disclosed anonymously
17656

17647 Mechanical registration of donor and receiver sheets in a processor

Disclosed is processor apparatus for registering the leading edges of two sheets before entry into the nip formed by a pair of contacting lamination rollers.

Viewing the drawing, image receiver sheet 1 is fed downwardly along inclined ramp 3 until its leading edge 5 abuts stop 7. Image donor sheet 9 is then fed upwardly along concave guide 11 from solution holding tank 13, which causes leading edge 15 of the donor sheet to push leading edge 5 of the receiver sheet from stop 7 and